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Advertisement Index, see page xxxvi

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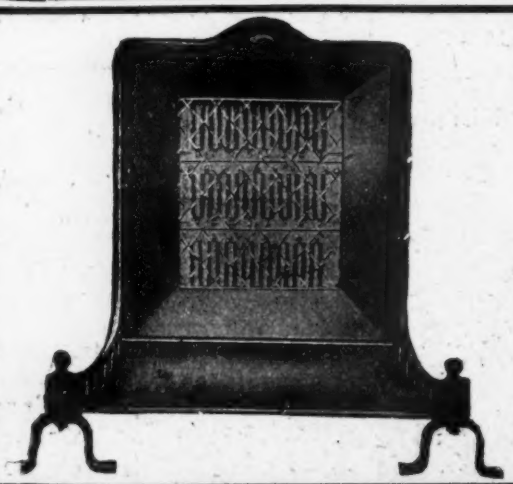

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Vol. LXXXVIII.] CONTENTS: January 28, 1921. [No. 2,253.

	Page
The Maintenance of Prosperity	97
London's Atmosphere	98
The Electron	98
International Symbols for Electrotechnics	99
I.E.E. Improvements	99
A Suggestion for Small Electricity Undertakings	99
On Statutory Earthing: Some Criticisms, by S. Loss (*illus.*)	100
Martin's Rotor Balancing Machine (*illus.*)	101
The National Industrial Council for the Electricity Supply Industry, by T. W. Cole	103
Legal	104
Correspondence—	
The Life of Metallic-filament Lamps	104
A 100 per cent. Load Factor	104
An Engineers' Club for London	105
The Telephone "Ramp"	105
Cost Sheets	105
The Constitution of the National Council	105
Atmospheric Electricity	105
German Competition in the Electrical Trade	105
To British Cable Manufacturers	106
Reliable Electric Irons	106
A Generator Problem	106
Shop Displays	106
Indicating Wattmeter in Remote Position	107
Charging Batteries for Motor Cars	107
Terminal Glands that ought not to be used in Connection with Electric Furnaces	107
New Electrical Devices, Fittings and Plant (*illus.*)	107
Business Notes	108
Notes	115
City Notes	117
Stocks and Shares	119
Market Quotations	120
The Physical Society's Exhibition (*illus.*) (*concluded*)	121
The Import Trade of India	122
Extra-High-Tension Distribution by Underground Cable	123
The Electrical Contractors' Association (Inc.)	124
Electrons, by Sir W. Bragg	125
Electric Arc Welding Applied to Aluminium, by F. J. Heyes	127
New Patents Applied for, 1921	128
Abstracts of Published Specifications	128
Contractors' Column	Advertisement page xxvi

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THE MAINTENANCE OF PROSPERITY.

DURING the period of greatly stimulated demand that followed upon the signing of the armistice, and which only now shows signs of abating, there has been unending discussion of the necessity for co-operation between employers and employed. This discussion has centred upon the question of production; some urged that the only way to regain prosperity was to increase production all the time, while others, fearing unemployment as a result of over-production, urged restriction of output, ca' canny, and other methods which they thought would keep up employment and a high level of wages. The arguments for both sides have been repeated so many times, and we have dealt with the matter in our leading columns so often, that we feel justified in taking it for granted that they are familiar to the minds of our readers.

Many methods of stimulating production have been devised and put into operation, some with conspicuous success, others with less noteworthy results. To judge from the frequent references that have been made to it in the Press, as well as from the fact that it is still in operation, the Priestman system is one of the most successful. It will be remembered that, under this system, the management conferred with the men's representatives, and the conference determined a certain standard rate of output for the factory, in Messrs. Priestman's case measured in tons of finished machinery. For this output the standard Trade Union rate of wages appertaining to the district was paid. Messrs. Priestman Bros., Ltd., increased this rate by 10 per cent. to obtain for the system the goodwill of the employés, but this is not an inseparable part of the idea. The output being fixed, it is reviewed every four weeks by the management in collaboration with the Works Committee, and the standard of remuneration for the four weeks next ensuing is based upon the percentage difference between the actual rate of production and the standard rate. The same percentage is applied to the rate of pay of everyone in the concern, from the general manager downwards.

This system has already been adopted by over 100 firms, and information concerning it has been supplied to nearly 700. If the effects produced are as satisfactory as they appear to have been hitherto in Messrs. Priestman's own case, the spirit of goodwill and co-operation which should result will, no doubt, have considerable bearing on the course taken by industrial problems. As a stimulus to production, the value of a system which apportions the results of increased productivity cannot be over-estimated; and while demand is brisk and production can be completely absorbed, this value is probably equally apparent to both sides. It is when a slump is threatened that the value of a stimulus to production is apt to be regarded as having diminished, if not disappeared, and this by both sides. The firm dislikes selling at a cheap price the goods which have been manufactured during a period of high production costs. The fall in prices is regarded by the worker as the result of over-production, and he jumps at once to the wrong conclusion that a smaller supply would raise prices again.

The fact is, of course, that while the potential demand is there all the time, it cannot be gratified during periods of financial stringency unless prices are lowered to a sufficient extent to render it possible for buyers to afford to buy. It is a well-known law of commerce that profits tend to disappear. We had better

reiterate, for the benefit of those who are liable to misinterpret the word "law," that in this case it does not mean a legislative enactment brought into being because somebody thought it desirable; it means that observation of a sufficient number of cases in which this result has come about, has made it possible to state, with practical certainty of fulfilment, that the same result will always be arrived at when the same causes are in operation. Profits tend to disappear. If a novelty is placed on the market, and captures the public imagination, it sells freely for a time at a high price. The demand will then either fall off, being satiated, or something else having appealed more strongly to it; or it will remain, in which case imitators will become active, offering similar goods and usually lowering prices a little in order to get a start in the market. The first article must then be made more attractive, either by the addition of extra features, or by a cheapening of the price. Even when a price ring is formed—a practice we believe we have heard of in other industries—the profits made are vulnerable by outside manufacturers, by decreasing efficiency brought about by over-confidence and by diminution of wholesome competition, and by the need for carrying the weight of the weaker members.

In view of this law, it becomes apparent that there is a constant need for the encouragement of output, almost regardless of the demands of the market. Production costs, whether of manufactured goods or of units of electricity, consist of running costs and overhead costs; and the overhead costs, remaining reasonably constant in amount, decrease per article or per unit as the output of articles or units increases. If production be allowed to fall off, the overhead costs per article produced will increase, resulting in a further diminution of profit; and this may easily go on to the point where production becomes impossible, and the cloud of bankruptcy appears on the horizon. The factory, to produce cheaply, must produce continuously, and in great volume. Now, if, during times of slack demand, it is necessary to put unusually large quantities of finished material into stock, clearly there will be an unusually large amount of capital locked up in the business, which may lower dividends—again a tendency, on the part of the profits, to disappear. A weak concern will probably not be able to provide the necessary extra capital, and, being faced with the two evils of increase of overhead charges or increase of capital, will go to the wall. This kind of thing operates in cycles, and is bound to be seen in the future as it has been in the past. Increased activity in the selling of the product is imperatively necessary, and this is the time for agents, middlemen, and all the class of wealth-handlers, so much distrusted and despised by Mr. Hecht, to show if they can be of service to the community or not. But, above all, it is necessary to produce economically, and to keep the strictest oversight on the costs. We have seen it stated that the necessity to-day is for production, to-morrow for sales. Let it not be forgotten, however, that production will be necessary to-morrow as well as to-day, to prepare for the day after to-morrow. In fact, production and sales must continually go hand in hand, and it is never safe, never has been safe, and never will be safe, to neglect either of them.

London's Atmosphere.

On January 1st an article on the London atmosphere appeared in our esteemed contemporary *Country Life*, in which Dr. J. S. Owens stated some facts which are of vital interest to something like six million people living in or near London. He invented and has been using a simple automatic instrument for measuring the amount of impurity in the atmosphere of London at all hours of the day and night. Briefly, it may be described as an automatic filter operated by clockwork, which at short intervals filters two litres of air, the suspended impurities being retained and weighed. With this apparatus Dr. Owens is able to trace the impurities of London atmosphere directly to the imperfect combustion of coal, a subject to which we have frequently drawn attention. Fortunately for sleepers with their windows open, the atmospheric impurities are at their lowest between midnight and 5 a.m. When people begin to start their fires for steam raising, and later for heating, cooking, &c., there is a marked increase in the amount of soot and other unconsumed combustibles in the atmosphere. It appears to have been proved that the hours during which fires are being started are the hours during which the atmosphere is most heavily charged with dirt, and, of course, even if no more were contributed by firing-up during the day, the original charge would take a considerable time to fall and settle.

Dr. Owens calculated that in some of the recent London fogs no less than 200 to 300 tons of sooty matter were suspended over the city. If people doubt this figure they should consider the further calculation that there are about 80 tons of soot emitted from London chimneys every hour.

Dr. Owens points out the immense importance of the atmosphere to the human organism. Whereas a man eats about 2.7 lb. of food and drinks about 4.5 lb. of water in 24 hours, no less a quantity than 30 lb. of air passes through his lungs in the same time. Obviously if this air is heavily charged with impurities, the fact is of greater importance than many questions concerning food, which receive much more attention. Dr. Owens calculates that in 24 hours of even moderate fog, no less than 5 to 6 cwt. of sooty matter is received into the lungs of the London population. He also states an incontrovertible fact when he says that the right way to deal with the difficulty is to stop making smoke. As is usual and correct, he lays a good deal of stress upon the contribution of the domestic fire. He suggests the use of smokeless fuel, and there can be no doubt that the general adoption of low-temperature distillation and the use of partially carbonised coal, or what might be called "half coke," would go a long way towards reducing the smoke and economising the coal, both items of practical and enormous importance.

We would venture, however, to point out that a still better solution would be the universal adoption of electricity for lighting, warming, and cooking in the domestic sphere, and for power purposes in the industrial sphere. This would not only restore the atmosphere of London to its original purity, but it would save carting about the country enormous quantities of heavy mineral, and would solve at one stroke all questions of congestion on the railways. This matter is, as we know, receiving the attention of the Government, and we hope it is serious in its intention to do everything possible to facilitate the development of electricity supply.

The Electron.

No phase of modern intellectual achievement appears to us more marvellous or inspiring than the astounding results which have been attained by the scientific men of all nations who have been engaged in the study of the electron during the past half-century. It was in 1881 that Prof. Crookes published an account of his experiments on "radiant matter," and his theory of a "fourth state of matter," in which, with the exercise of scientific imagination of the highest order, he foreshadowed the discoveries of the twentieth century. "Forty years on" we are thrilled and spellbound by Sir William Bragg's masterly exposition of the present state of knowledge on this most fascinating subject, and are amazed at the manual dexterity and mental insight with which the modern physicist has explored the ultra-infinitesimal constitution of the atom, analysed, weighed, and measured the speed of its constituents, and divined the nature and properties of the ultimate particle of negative electricity. All this has been done without ever seeing or touching the electron, for even the smallest atom has a radius of the order of 10^{-8} cm., while the shortest wave-length of visible light is 4×10^{-5} cm., and the radius of the electron, if it is spherical in form, is less than 10^{-13} cm. We can never hope to see an atom, no matter how powerful

our microscope; still less, therefore, is the prospect of seeing an electron—yet our men of science, with the eye of imagination, have pursued it in its giddy flight, have marked its passage through the atom (which they think of as "a very empty affair"!), have seen it "chip" other electrons off their mother-atoms, and have learnt that it maintains a close relationship with electromagnetic waves, so that either "can always call up the other" in accordance with definite laws.

It is here, especially, that Sir William Bragg can speak with paternal authority, for it is to him, and to his distinguished son, that we mainly owe the discovery of the nature of X-rays and their application to the solution of the problem of crystalline structure, of which he so modestly gives a brief account in his lecture—one of the best of the Kelvin lectures that have been delivered before the Institution of Electrical Engineers. We feel that this admirable essay, couched in the most lucid terms, and capable of comprehension by the most unmathematical reader, should be in the hands of everyone who is interested in the study of electricity, and therefore we are reproducing it *in extenso;* it will form a landmark to which we shall look back, years hence, when the riddle of the positive nucleus of the atom has been solved.

International Symbols for Electrotechnics.

We have this week received from the general secretary of the International Electrotechnical Commission, Mr. C. le Maistre, Publication 27 (revised) on International Symbols, which has just been issued. The new Report differs but little from the original issue, the notes relating to enemy countries having been deleted, and symbols added for electric difference of potential (V) and magnetomotive force.

So long as the Institution of Electrical Engineers refrained from adopting the International symbols in its *Journal*, we did not feel called upon to introduce them into our pages. However, the Institution of late has been using the code, and the American publications have also come into line. We have, therefore, followed the same course, commencing with our first issue of this year. Frankly, we do not like some of the compound symbols, such as kWh, in which "lower-case" letters and capitals are mixed; nor can the linotype machine provide the bold-faced type which is specified for the unit symbols, so that the ordinary type used for the text has to be employed. The use of italic capitals for the symbols for quantities presents another difficulty, but this occurs only in formulæ, and is of little moment compared with the employment of Greek letters, which are not included in the linotype founts, and have to be inserted by hand.

The advantages of a uniform notation are so cogent, however, that it behoves us all to comply with the code of symbols as closely as possible.

Contributors may be interested to know that fractions in formulæ should always, if possible, be written with the solidus (/) instead of the horizontal bar, because the latter cannot be used with the linotype, and enormously increases the labour of setting by hand, owing to the special spacing that is necessary between the lines, and other technical difficulties. In using the solidus great care is desirable, to show clearly what terms are included in the numerator and the denominator of the fraction.

I.E.E. Improvements.

The informal meeting of the Institution of Electrical Engineers on Monday last, to discuss means of increasing the usefulness of the Institution, was notably successful; there was a large attendance of members, including a number of Members of Council, who doubtless came prepared for anything. As a matter of fact, the meeting was as harmonious as the regular informal meeting always are, and more so than some formal meetings that we have attended.

Criticism of the Council was almost wholly absent; in opening the discussion, the Chairman (Mr. Pooley), whose conduct of the proceedings was admirable, struck the keynote of helpfulness, and the high tone was maintained throughout. A long letter from Mr. Purse to the President was read, in exactly the same spirit, indicating his desire to promote the efficiency of the Institution in every possible way. The suggestions put forward by the various speakers offered little novelty; they included the status question, keeping the library open in the evening, joint meetings with other societies, provision for the discussion of commercial subjects, the development of the social side, support to the Engineers' Club, the provision of an electrical laboratory, closer touch with the public and the lay Press, popular lectures, exhibitions of apparatus, &c. At the conclusion of the discussion Mr. Atkinson reviewed the proposals in a sympathetic spirit.

While the meeting is not likely to have much effect on the course of events, it was noteworthy for the atmosphere of co-operation and cordiality with which it was imbued, and was well worth while if only for that reason.

A Suggestion for Small Electricity Undertakings.

It is not to be supposed, of course, that electricity supply undertakings in small country towns have very ample funds for the purpose of advertising or publicity campaigns. On the other hand, they have the advantage of being, if they like, in close personal touch with practically everything that is going on in their small areas. Consequently, there are indirect possibilities open to them that do not generally obtain in bigger towns. They can readily interest themselves, and often take a part, in public or semi-public movements to benefit or expand the trade of the town, or even do something themselves to initiate them.

For instance, there is the pressing question, in which the Government is interested, of reviving industries of all kinds in country towns. There are, though it does not seem to be very widely known, Development Commissioners for the very purpose, *inter alia*, of helping forward agricultural development and rural industries. The main procedure is to encourage local authorities, county councils, or associations to organise local efforts, and generally encourage and help forward co-operative developments. And it is no bare benediction that the Commissioners give, but hard cash in the shape of grants, where they approve, of course, for such purposes of propaganda. Now, all this is to the benefit of the local electricity undertakings. Would it not be worth the while of some of the small country undertakings to try to stir up their local Councils to make some such move, and get the support of the Development Commissioners? It might result in considerable good to the town and, in a subsidiary degree, to the undertaking.

Let us cite, as a small example, the Agricultural Organisation Society, which receives a grant from the Development Fund, and has helped in the establishment of the Swanwick Basket Factory in Hampshire. This is a co-operative factory jointly promoted by the Fruit Growers' Association, and started work in 1914. The various strawberry growers of the district decided to co-operate and make their own fruit baskets, and the venture has turned out to be eminently successful. The aspen logs are sawn down, the peeling machines strip down the wood to the ribbons of veneer, the guillotine cuts these to length, the baskets are woven and shaped and then finished in a wire stitching machine. Here, then, is a factory of direct benefit to an undertaking both for power and lighting, and entirely due to organisation—or, in the first place, brains and initiative. There must be plenty of opportunities up and down the country for similar developments. The whole question is one of stirring up local effort. When local interest is once aroused, help is always forthcoming from the Agricultural Organisation Society, if it is in its line, or some other Society, or, as we mentioned before, the local authorities themselves could take the whole matter in hand and get all their expenses for organising and so on paid out of the Development Fund if they satisfied the Commissioners that they were helping forward rural industries.

ON STATUTORY EARTHING: SOME CRITICISMS.

By S. LEES.

In the official Memorandum on the Home Office Electricity Regulations (*vide* Factory and Workshops Acts), it is provided by Regulation 21 that: "Where necessary to prevent *danger* adequate precautions shall be taken either by *earthing* or by other suitable means to prevent any metal other than the *conductor* from becoming electrically charged."

Admittedly one of the most important of the thirty-odd articles in the Memorandum, it is probably not an exaggeration to assert that more irregularities occur in its daily observance than with the rest of the whole code, for a really efficiently and properly earthed system seems to be becoming somewhat of a rarity, and an installation complying with the letter and spirit of Regulation 21 certainly commands due appreciation when met with.

Almost, if not quite, the most elementary item of the journeyman electrician's mental stock-in-trade, it seems somewhat curious that the important measure referred to should be, apparently, so little understood, since commonsense rather than profound electrical knowledge is manifestly the one quality most required in performing this important and almost invariably simply achieved statutory requirement. And commonsense applied here means just the ability to discern and discriminate between essentials and non-essentials as, for instance, the difference between water main and water service pipe; to distinguish between water and steam (including heating) or other dissimilar pipes; or to determine the street and service sides of a water supply system, and to avoid mistaking gas barrel and compo. for water piping. Further, to detect points of potential, as well as of actual, weakness in any system liable to cause interruption of electrical continuity, such as packed pipe joints and couplings of various kinds, valves, cocks, meters, and other apparatus. Neither is it wise to assume that all possibly is in order with an earth wire which may be continuous and visible up to the point of its entry into the ground; nor should too much be taken for granted because the said earth wire may resist a strong pull against uprooting.

In connecting massive apparatus of relatively small bulk as, for example, a generator or motor frame, transformer case, &c., with earth, to ensure a cable or strip connection thereto having a 100 per cent. conductivity throughout is a simple proposition to any tradesman worthy of the name. The position, however, becomes somewhat different and perhaps more difficult when, say, considering an overhead travelling-crane equipment, or in dealing with an installation of metal conduit. Here, every tubular or other purely mechanical joint or special fitting which exists in the system may be viewed as a potential source of electrical weakness; a defective coupling next to the earth conductor proper may conceivably quite easily break the continuity, and thus insulate the whole system from earth. Were it even necessary it would still be found impracticable to bond all such points separately in an efficient manner, hence the extreme importance of providing that all tubing and fittings in a conduit system shall be sound and properly attached both electrically and mechanically, so as to ensure a practical 100 per cent. continuity throughout.

It cannot be gainsaid that even with the screwed conduit system the greatest care is necessary when installing, especially in attaching fittings, as contrary to common notions a threaded joint does not always produce sound electrical contact although such a joint may be, mechanically speaking, quite above suspicion, the natural tendency of the V-screw thread pair having properly formed and finished surfaces being to *slide* and not to *cut*. The truth of this fact may be demonstrated in a practical manner by joining together a piece of common steel conduit tubing and an ordinary fitting —bend, elbow, coupling, tee-piece, &c. The tubing should preferably be cut in a sound die, and an unpicked stock fitting (one of the kind enamelled inside and out) used for this test. On unscrewing, the threaded surfaces of the tube and fitting will almost invariably be found to be highly polished and lustrous, due to the enormous frictional or rubbing effect produced during the process having driven the enamel into the pores of the metal and formed an extremely hard and burnished coating of a high insulating value on the threaded surfaces. Sometimes with badly cut threads choked with enamel a false sense of security is given owing to the superfluous enamel binding the surfaces and being mistaken for a tight thread. Such a joint obviously is worse than useless as an electrical bond, hence, as previously remarked, the extreme importance of ensuring that all joints and connections be properly and soundly made. "Ohms at the terminals with infinity on the tubing means midnight oil and nervous breakdown." As is well known, a turn or two with a good tap will invariably clear a dirty threaded fitting, and formerly this precaution was but rarely neglected in installing screwed barrel. One feels that this commendable practice might with advantage be revived to-day. The writer has experience of numerous instances where "earthed" conduit runs have been completely severed owing to overheating and arcing at defective joints caused by the development of earth faults. The commercial impracticability of applying a "drop" test as a means of detecting unsound joints of the kind mentioned is obvious, nor is it necessary. With the slip-joint (so-called) and non-screwed systems

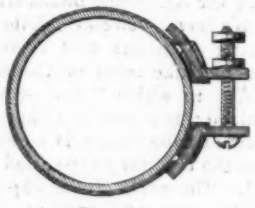

FIG. 1.

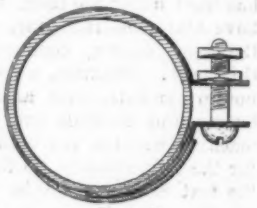

FIG. 2.

the difficulty of ensuring continuity is intensified, and notwithstanding the many ingenious attempts made in the past, the solution of this problem appears to be as far off as ever. Tubing of this class, moreover, has a somewhat limited field, and it would not be very surprising if in the near future the further use of conduit the chief advantage of which is that of cheapness were abandoned. So much for continuity.

The conventional methods of attaching earth devices are, generally speaking, unsatisfactory. Of various types, and mostly proprietary, these fittings invariably depend primarily on the contact effected by clasping a circular metal clip or band around the metal conduit, the earth conductor proper being attached to the clip or band by means of an ordinary bolt and nut or set-screw, and in some cases by a wedge device. For commercial considerations doubtless some such fittings are stated to be of a universal type, inasmuch as the heavier component parts of the clip are of a uniform size and non-adjustable, whilst the flexible member, which is capable of being extended or reduced to suit different sizes of pipe, grips the conduit; these are claimed to fit all standard sizes of conduit. One example of this type which has a fairly wide vogue makes electrical contact with approximately three-fourths of the circumference of the tubing to which it may be attached, at its maximum adjustment. In the design of this

contrivance no consideration appears to have been given to the relation between capacity of tubing and earth conductor; presumably it being intended to connect two or more clips in parallel. Again, at about half a dozen points joints occur making local contact only with the flexible band, which depends for its ultimate tightness on compression by a single 3/16-in. screw, the earth wire also being connected by the same screw. As already remarked, this device depends primarily on circumferential contact between the adjustable flexible member and the conduit, which is wholly inadequate; this serious disadvantage might be compensated to some extent at least by a proper proportioning of the size of clip to capacity of conduit, provided a sufficient area of truly faced and clean contact were assured on the external surface of the conduit. In actual practice, however, that is but rarely the case, rather the reverse is the fact. It may be urged that meticulous accuracy is unnecessary, but the electrician has to remember that clearance is not for electrical contacts, but for engine cylinders. For checking contact surfaces of earth clip connections an ordinary fitter's tapered feeler-gauge is a very useful substitute for the more conventional milli-voltmeter and far cheaper. Fig. 1 illustrates the device just described. Such a relatively thin

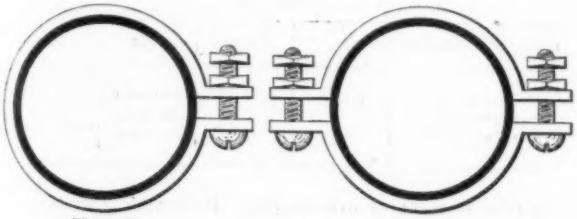

FIG. 3.

FIG. 4.

and narrow band of soft copper strained in position will naturally stretch, and eventually work loose, thereby rendering the connection useless. The form of clip shown at fig. 2 is limited in its application, for obvious reasons, to the smaller sizes of tubing, and in addition to being mechanically weak has most of the disadvantages of its relation pictured in fig. 1. The common plain clip, fig. 3, although of a robust pattern, requires to be very accurately made and carefully fitted in order to ensure efficient electrical contact; very often local or point contact only is effected, as a result of erratic filing or scraping of the surface of the conduit. Under unfavourable atmospheric conditions such a connection rapidly deteriorates, and is soon rendered useless. The form of split clip shown at fig. 4,

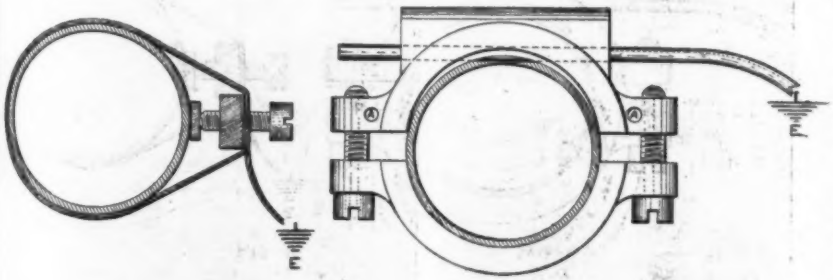

FIG. 5.

FIG. 6.

although somewhat easier to fit than its predecessor, possesses the same inherent disadvantages, and as usually made of cast brass is liable to fail through over-strain at the lugs. With both of the latter types of clip it is manifestly necessary to carry stocks of as many sizes of clips as tubes—an expensive disadvantage. A contrivance sketched on the lines shown at fig. 5 is often used in telephone and bell practice, but when applied to power and lighting circuits is an abomination, and its use should be condemned. It seems rather curious, by the way, that water supply authorities should countenance the use, or rather the abuse, of such a crude and damaging contraption on their property. A type of earthing grip which is somewhat of an innovation is illustrated at fig. 6. The method of connecting the earth conductor to the grip socket is novel, and good contact is effected. To the writer the weak points in its design lie in the small area of contact obtained between the earth wire and the surface of the conduit, as the pressure required to flatten a solid or even a stranded cable to any appreciable extent would be enormous, and in the commercial sample inspected the grip would probably give way at points A if unduly strained. Stranded cable should be used in preference to solid wire, as better contact would thereby be effected, and the risk of damaging the grip and screws avoided. The screws perform the dual function of securing the grip and also of locking the earth conductor to the conduit; it is not inconceivable that the conductor, especially if a solid wire, may shear off inside the bore, or the grip may work loose, and the earth wire would in that eventuality probably get disconnected. There are also several patented earthing systems in which special perforated or slotted metal strip is entwined around the tubing and fastened into position by means of screws, the strip forming the dual function of clip and conductor to earth. The strip systems are not extensively used; of relatively low carrying capacity, in addition to mechanical weakness the necessity of joints is a bar to their adoption to any great extent. All the devices described in the foregoing depend absolutely on the conduit surfaces being of sufficient area, truly faced and clean, and are subject to the various troubles arising from imperfect or local contact and, in the writer's opinion, are unsatisfactory for armoured cables. One might continue thus indefinitely, but it will be sufficient to indicate that the different forms of devices illustrated are representative of the commercial earthing fittings in present-day use.

(To be concluded.)

MARTIN'S ROTOR BALANCING MACHINE.

THE apparatus described herewith was designed by Mr. W. H. Martin, and is a product of Messrs. F. A. Pullen and Co., for the purpose of affording a quick, safe, and inexpensive method of balancing rotary bodies, and it gives very accurate results. In an existing machine the sensitiveness of the balance is such that when, for instance, balancing a rotor of 10,000 kg. it will easily show a variation of balance of 1 kg. cm. by sliding a weight of 1 kg. along the beam. This corresponds to a deviation of the centre of gravity of the rotor in a horizontal direction off the axis of 0·0005 mm., or approximately one-fifty-thousandth of an inch.

To express the above result in a more concrete way: when for example, balancing a 10-ton Zoelly rotor of 6 ft. diameter, an overweight of 10 grammes (one-third oz.) on its circumference, or one-millionth part of the rotor's weight, can be readily detected. It is always possible to detect, locate, and correct an "out-of-balance" moment of 1 in.-lb. present in a rotor or such-like body.

Another advantage of the apparatus is that it indicates the correct plane in which this overweight lies and its moment would act, a feature that is unique and greatly increases the accuracy of the results obtained. These results are obtained without rotation, as it is merely necessary to turn the body to six or eight fixed positions, and when actually balancing no rotation takes place. The method is not affected by the body's inertia, neither is there any fear of an "angle of lag" upsetting the result.

The machine, figs. 1 and 2, consists of two main portions arranged to support the shaft of the rotor to be balanced. At one end the shaft is hung in a universally-jointed stirrup, fig. 3, and at the other in a bearing which is

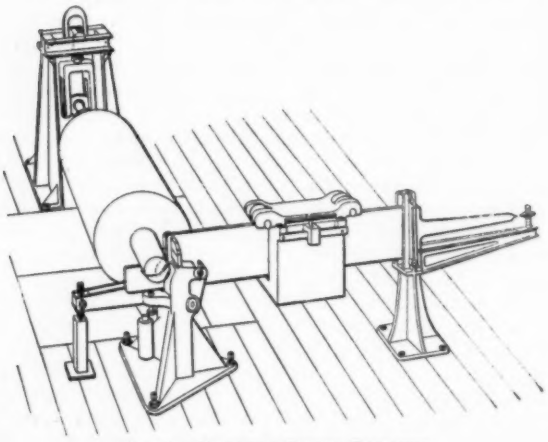

Fig. 1.—Martin's Rotor Balance.

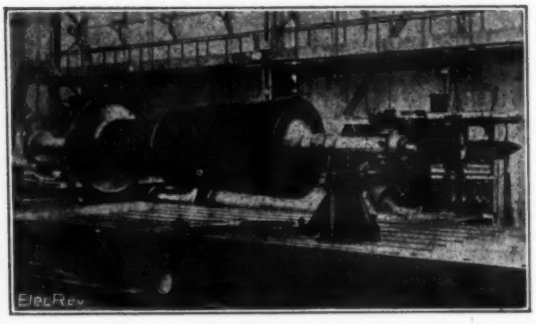

Fig. 2.—A 7-ton Turbine Rotor on Balance.

mounted on the short arm of a steelyard lever, figs. 2 and 4.

Having placed the rotor to be balanced in the bearings, the main weight of the steelyard is adjusted so as to bring the arm into equilibrium. The rotor is then turned a few degrees and the arm again adjusted by moving the jockey weight; this adjustment is recorded. The rotor is then turned through another section, and the necessary adjustment again made by means of the jockey weight, and so the process is continued for a complete revolution. The results are plotted to a horizontal base, and the sine curve obtained shows a maximum and minimum which indicate the points at which the centre of gravity is furthest from, and nearest to, the supporting point of the balance. By multiplying the jockey weight by its displacement, a moment is derived from which the eccentricity of the centre of gravity and the necessary correction are obtained. Table I gives some actual results that have been obtained with a large balance.

That this type of balancing apparatus is also suitable for extremely small and accurate work is shown by Table II, which result was obtained on a small size machine by Dr. Archibald Barr (Regius Professor of Glasgow University), at his range-finder works, at Glasgow.

Recently the excessive vibration set up in a power-house and neighbouring buildings by the unbalanced armature of a 450-h.p. steam-driven dynamo set was entirely remedied, after balancing on the above-described machine.

On all built-up turbines, such as the Zoelly & Curtis types, first the shaft and then each disk put on is successively balanced; the final balance obtained will then be without any disturbing couple, and many times more accurate than any result obtainable by other methods. In a drum-type turbine, such as the Parsons rotor, the overweight is taken out partly at each end in relation to the position of the centre of gravity, the sum of this moment being equal to

TABLE I.

Rotary bodies balanced.	Weight, kg.	Out-of-balance moment found, kg. cm.	Weight removed (dependent on the radius), kg.	Corresponding correction of rotor's c. of g., mm.
H.p. turbine rotor...	2,678	3·75	0·208	0·014
L.p. turbine „ ...	5 370	5·8	0·23	0·0108
H.p turbine „ ...	6,792	36	1·35	0·053
L.p turbine „ ...	9.103	13·2	0·244	0·0145
H.p. turbine „ ...	6 781	21·7	0·8	0·032
L.p. turbine „ ...	9 216	34·1	0·695	0·037
H.p. turbine „ ...	7,200	10·8	1·391	0·015
L.p. turbine „ ...	9,203	58·9	1·1	0·064

TABLE II.

Rotary body balanced.	Kg.	Kg. cm.	Kg.	Mm.
Gyro wheel 5¼ in. diameter for gyro static compass.	2·973	0·00036	0·000054 (54 milligrammes)	0·00121 (about 1/20,000 in.)

the total moment of over-weight. Reduction gear wheels can also be balanced by this machine, and for bodies which are of relatively large radial and small axial dimensions, a mandrel (in itself balanced) to take such parts can be used on the machine. The machine could also be used for standardising rotary parts.

In his patent specification the inventor claims a precision in determining the eccentricity of the centre of gravity ten times as great as that attainable with the methods hitherto employed, such as that of rotation at a high speed.

Messrs. Yarrow & Co., of Scotstoun, after investigating the matter, have adopted one of these machines for their own works. Similarly, the Royal Shipbuilding and Engineering Co. "De Schelde," of Flushing, Holland, is using such a machine with great satisfaction, and various other firms are considering the adoption of the apparatus.

Fig. 3.—Universally-jointed Stirrup.

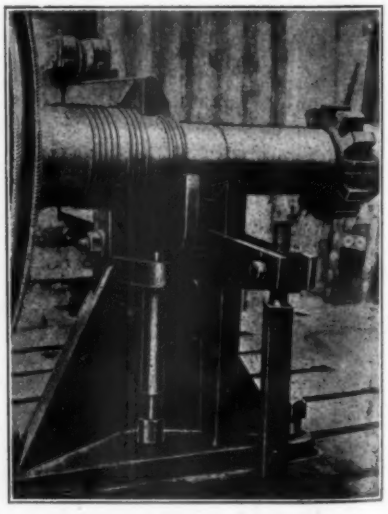

Fig. 4.—Balancing Beam Bearing.

THE NATIONAL INDUSTRIAL COUNCIL FOR THE ELECTRICITY SUPPLY INDUSTRY.

Proposed Reconstruction.

By T. W. COLE,

Joint Secretary, No. 9 (Home Counties) District Council.

SOME little time ago, at one of the meetings of the Home Counties Council, Mr. Hesketh, of Folkestone, presented a report in which he suggested that steps should be taken by which each District Council might be represented directly on the National Industrial Council. We discussed the matter, and, like most people faced with a new proposal, saw the difficulties much more than the advantages, and so for the moment held our hand. But gradually we became aware that the same feeling as to the need of direct representation on the National Council was becoming universal. This widespread feeling all over the country crystallised eventually in a definite resolution to the effect that, when the time came round again to nominate the members of the National Council, direct representation should be secured. This resolution was drafted by the employers' side of No. 3 District Council, and first submitted to the employers' side of the District Councils at a meeting held at the Ministry of Labour on January 6th. I confess that at that meeting, as an early speaker in the debate, I opposed the resolution. But the meeting generally was all out for it, and very cogent arguments indeed in support were forthcoming, and the resolution was carried. The next day there was a further meeting at the same place, at which the employés' side of each of the 13 District Councils was officially represented, and also the National Council by 10 of the 12 members. The "constitution of the National Council" was the first motion on the agenda, and ran as follows (the same resolution as on the preceding day):—

"That it be a recommendation of the National Council that the National Council should be composed of 26 representatives on each side; that the allocation of seats on the employers' side should be 13 for the companies and 13 for the local authorities; that the company organisations in electing their representatives should endeavour to secure that a representative is elected from each district; that the local authority representatives on the National Council should be one from each District Council and should be elected by and from local authority representatives on the District Councils."

The minutes of this meeting triumphantly record that the resolution was "carried unanimously." So much for the views of the employers' side. Then came the task of submitting the resolution to the trade union side at the combined meeting, held on January 20th, at Montague House. Unfortunately, the trade union sides of the District Councils had not had the resolution submitted to them, and so had to face the resolution appearing on the agenda paper quite unprepared. Further, although the resolution implies that the trade union side of the National Council shall be selected from the District Councils, there are no specific words to this effect. Mr. Rowan, in a most admirable speech, led the opposition from the point of view of the trade unions, but there was evidently a good deal of division of opinion on the trade union side, and a strong feeling was expressed that it should have had an opportunity of discussing the matter before coming to the conference. My own Council, the Home Counties Council, however, was blameless on this point, as we had already come to agreement on the matter in full council of both sides, and were prepared to vote in favour of the resolution accordingly. But none of the other District Councils appeared to be in such a position, so a registration of the votes of the individual Councils was out of the question, and the motion was followed by merely a personal "show of hands." After all, it was too much, perhaps, to expect the perplexed and unprepared trade union representatives to vote off-hand, and commit themselves on such a serious proposition. The "show of hands," needless to say, counted against the proposition. The conferences, however, have been most useful, as every District Council has heard all sides discussed, and should now be in a position to deal confidently with the question at an early meeting of its full council. The next step, therefore, for the District Councils is, presumably, to take a vote as we of the Home Counties Council did, of both sides. Bearing in mind the "unanimous" carrying of the resolution by the employers' side of the District Councils at the meeting on Jan. 7th, already mentioned, it would look as though it were only the trade union side, at least mainly, that remained to be convinced. Anyhow, the task now for each District Council is to discuss the matter in full council, and take a vote on the matter. When this is done, therefore, and the votes of the 13 District Councils are collected, the matter will formally be in order for action, if any, to be taken. Until such definite vote is forthcoming, of course, despite conferences and so forth, there would be no grounds to justify the Minister of Labour approving any proposal.

Now as to the proposed change in the constitution of the National Council. First of all taking the employers' side, the change does not necessarily mean a change in the personnel, but merely an addition of new members. For instance, Alderman Beaumont sits on the present National Council because he was nominated thereto by the I.M.E.A. in virtue of his valuable services on No. 10 District Council. In the reconstituted National Council he will sit there because he will be nominated by No. 10 Council in virtue of precisely the same services. Mr. Bailey sits on the present National Council at the nomination of the Conference of Chief Officials. He would still sit there by exactly the same nomination, but would be understood also to represent No. 10 Council, if No. 10 Council concurs, which may be "taken for granted." Mr. Woodhouse would also sit as a nominee of the Power Companies' Association, with merely the almost theoretical addition that he also represented Yorkshire District Council. The same applies, of course, *mutatis mutandis*, to the other members. In fact, if we might adopt a terpsichorean simile, there are 13 District Councils as wall-flowers, and the present members of the National Council will be told to "set to partners." Of course only part will be thus temporarily united, and there will still be a balance of "wall-flowers" for which new "partners" must be elected. And the only "reconstitution" is that these surplus spinsters, so to speak, should be provided with partners. The three Company Employers' Associations would still retain their nominating powers, but in concert with the District Councils, and surely the most punctilious purist could not take exception to such an innocent *ménage à trois*. The case of the municipal representatives is even simpler, since the I.M.E.A. drops out altogether and each member is elected by his District Council "on the spot."

There is one point also which is universally taken for granted by all the reformers unanimously, and that is that the present chairman, Alderman Walker, continues in office; the whole new scheme presupposes that. We are not afraid of the size of the Council interfering with its work or effectiveness provided Alderman Walker is in the chair.

The chief argument advanced against the increased National Council, and we admit that it has a certain force, is that it will be like "the old lady who lived in a shoe." But even this old lady manipulated her troubles successfully—and the difficulty of numbers is not insuperable. No. 10 District Council has found

a very businesslike way of dealing with such a case by appointing an Executive Committee, the full Council meeting, I believe, once a month, and the Executive once a week. *Mutatis mutandis*, something of this kind could obviously be done by the National Council.

Now as to the trade union side; I speak with diffidence here. (I am a *nouveau riche* as regards my trade union lore. In ante-Whitley days, or at any rate, in *ante-bellum* times, many of us had only a bowing acquaintance with trade unions. During the war "intimacy ripens.") Anyhow, it does seem to me that trade unions have everything to gain and nothing to lose by regional representation on the National Council. It is certainly in principle more democratic that those who form the higher court, so to speak, should be elected by the same union representatives whose interests are being dealt with. The trade union representative on the District Council ought not to be supposed merely to keep his nose down on to merely local matters in an isolated kind of way, but to treat these in a broad spirit and in right relationship with the broad lines of policy dictated by the wider interests of the industry nationally. But how is he to do this, if he is told to keep to his mere local business, and leave all these bigger matters to be dealt with by "headquarters?" In respect of these matters for which he is responsible, he ought to be there representatively himself. Further, his unintermittent experience of the detail work of the District Council specially fits him to deal adequately with the work of the National Council. To be able to see the job right through either personally or representatively would add enormously to his interest in it, and incline him to put his best into the work of the Whitley scheme to the benefit of all concerned. The present is the unique opportunity for the District trade union representatives to declare: "We are going to be in it, all the time, all the way through."

Again, and this is a point on which I think all constructively-minded members will agree, both employers' side and trade unionists, by making the National Council directly representative of the District Councils, the whole scheme becomes organically complete. It becomes one machine, structurally sound. Not only is each District Council vitally connected with the National Council, but, through the National Council, the District Councils become welded together into an organic whole. At present we are all so many isolated units, each going on its own way merrily, without any regard to the good of the whole. This is not our fault, but the fault of the organisation, for, barring eavesdropping, we have no means of even knowing what any other is doing.

Finally, the proposed reconstitution will make the whole scheme more highly Whitleyised. The Whitley report says: "*The National Industrial Council should not be regarded as complete in itself;* what is needed is a triple organisation—in the workshops, the districts, and nationally. Moreover, it is essential that each of these stages should proceed on a common principle, and that *the greatest measure of common action between them should be secured.*" In another report, it urges "each of these three forms of organisation (*i.e.*, Works Committees, District Councils, and National Council) being *linked up* with the others so as to constitute an organisation covering the whole of the trade."

It is to secure such "linking-up," and to prevent the National Council being "regarded as complete in itself," that the reconstitution is proposed. *Fiat referendum.*

Architecture Exhibition at Ghent.—The International Architecture Exhibition, organised under the auspices of the Government, will be opened at Ghent on April 30th in the Palais des Fêtes. The scope of the Exhibition will be a very wide one, as not only will it deal with architecture properly so-called, but also with everything concerned with the modern arrangements of houses and offices. Thus, furniture, pianos, carpets and hangings, heating and lighting apparatus, the newest ideas for bathrooms and the most modern electrical appliances will all find a place in the Exhibition.—*Reuter's Trade Service* (Brussels).

LEGAL.

MORROW *v.* STEPNEY BOROUGH COUNCIL—APPEAL.

In the Court of Appeal, before the Master of the Rolls and Lords Justices Warrington and Scrutton, on January 19th, the case of Morrow *v.* the Stepney Corporation was heard upon the defendants' appeal from a judgment of Mr. Justice P. O. Lawrence, granting an injunction restraining the defendants from discharging grit and ashes from the chimney stacks of their works so as to cause a nuisance to the plaintiff, who carried on business as a mast, oar, and scull maker in Brightlingsea Place, Limehouse. Mr. Justice Lawrence also awarded the plaintiff £50 as general damages for the discomfort he had suffered and the costs of the action.

The action was reported in our issue of June 18th, 1920.

Mr. JENKINS, K.C., in support of the appeal, said it was really brought for the purpose of taking the case to the House of Lords. Mr. Justice Lawrence had found as a fact that a nuisance was caused to the plaintiff. Defendants contested that at the trial; but he was not prepared to ask their lordships to review the judge's findings of fact. But the important point of law which the defendants wanted decided was whether, having regard to the defendants' statutory position, they had not the right to do what they had done, and whether or not the plaintiff's only remedy was compensation. Another point for consideration was whether the learned judge had exercised his decision rightly in granting the injunction. The operation of the injunction had been suspended pending the present appeal. If the injunction was granted it would no doubt inflict considerable hardship on a great number of persons.

Without calling upon counsel for the respondents, their lordships held that they could not interfere with the judgment of Mr. Justice Lawrence, and dismissed the appeal with costs.

ELECTRICAL INDUSTRIES, LTD.

In the Companies Winding-up Court, on January 19th, Mr. Justice Astbury made an order for the compulsory winding-up of Electrical Industries, Ltd. Mr. Bischof, for the petitioners, R. Johnston & Co., Ltd., said they were judgment creditors for £375. No notice of opposition had been received, and the company did not appear.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Life of Metallic-filament Lamps.

Referring to "Dudlux's" letter of the 14th inst., I should like to state that I experience similar results with metallic-filament lamps. Occasionally one gets a lamp which burns for about 500 hours, but this is decidedly the exception to the rule.

Generally speaking, the average life is about 200 hours for ordinary metal lamps, and 100 hours for "half-watt" types. In the first place, "½-watt" lamps were installed to replace large arc lamps, with a view to reducing current consumption. However, far from being economical, the high cost of renewals more than balances the running costs of the arc lamps.

One is rather loath to have to resort to the ancient carbon lamp, but apparently there is nothing else for it.

J. W. H.

January 19th, 1921.

A 100 per cent. Load Factor.

I should like through the medium of your journal to ask the attention of electricity supply engineers to the question of quoting special rates for appliances of fixed capacity working continuously day and night.

Some years ago an interesting device for storing energy in the form of hot water was introduced, and a good many supply undertakings did at that time quote low rates for the energy taken by this apparatus, using no meter and sealing the connections.

Recently a good deal of attention has been given again to appliances of this class, but inventors are being discouraged by the reluctance of supply undertakings to quote special rates for such supplies.

It is, I believe, argued that because the 100 per cent. load factor apparatus operates across the peak it does not justify cut prices for energy.

It must be remembered, however, that these appliances would be used to a great extent on parts of the mains network where loading is at present intermittent, and the load factor on the cables low. Moreover, in most stations, the actual peak occurs in the winter time, and lasts for a very short period, and a rate might be calculated to take into consideration the overlapping of this short peak.

For example, if 8d. a unit is the price for supply taken on the peak, and 1d. a unit would be profitable for, say, a

3-hours' supply taken off the peak, it is obvious that an all-round figure of 1½d. would meet the requirements and probably encourage a very desirable load of this kind.

The matter should receive sympathetic attention because the water heating problem is largely bound up with the storage of electrical energy on the consumer's premises in the form of heat. Moreover, there is indication to-day of further interesting inventions for heating, these probably await for their development only the encouragement of the supply engineer in the form of suitable tariffs.

It would be interesting if you could obtain the views of engineers on this subject.

J. W. Beauchamp,
Director and Secretary,
Brit. Electrical Development Association, Inc.

London,
January 18th, 1921.

An Engineers' Club for London.

It is extremely encouraging to see the efforts that are now being made by Mr. Hill and his colleagues to form an Engineers' Club in London, linked up with other proposed Engineers' Clubs in provincial cities, including naturally the pioneer of them all at Manchester.

Considering the fact that our city is justly acclaimed as the centre of the majority of the world's human activities, and that civilisation in its material expression is mainly the work of engineers, there should be no special pleading required to obtain a generous moral, intellectual, and material support for this enterprise.

It is, therefore, to be hoped that engineers will get into touch with Mr. Hill's provisional committee at the earliest possible moment to ensure that the scheme may be launched with the least possible delay, and that in the near future we may have the finest club in this country available for recreation, social intercourse, and professional discussion, together with feeding and sleeping facilities on a level with those to be found at a first-rate hotel.

This scheme should interest not merely the 3,000 engineers in the city who are called for, but at least 30,000, and perhaps many more.

Raymond J. Mitchell,
A.M.I.E.E., A.M.I.Min.E., &c.

London.
January 18th, 1921.

[Our correspondent has accurately defined the institution which the promoters aim to set up. It is going to be a very big thing—if those who wish it to exist will give the scheme their support *now*.—Eds. Elec. Rev.]

The Telephone "Ramp."

Your leader of the 14th appears to inflict an unmerited injustice upon many readers, telephone subscribers, and would-be victims, especially those who were too young in 1911 to be interested.

How can the Post Office penny be compared with any other? If so, when did the Post Office telephones and telegraphs make a profit? The Postmaster-General says they cannot develop the system until manufacturers deliver the goods; we may ask ourselves, therefore, what will replace the present penny when his department really begins to spend?

All the present official statements are interesting, if alone for the careful avoidance of the only issue that does matter, and that is: When is the department to be run on business lines?

Telephony.

January 18th, 1921.

Cost Sheets.

Referring to the article by Mr. Clegg in your current issue, dealing with cost keeping in an electricity supply undertaking, I should like to inquire if the author is quite satisfied that sufficient detail is shown. Surely lumping together all work on engines, boilers, &c., is not good enough.

Costs, to be of practical use, so as to enable the engineer properly to control works costs, must be shown in more detail. For example, some boilers may be hand-fired, others fitted with automatic stokers, whilst others burn oil fuel, or even powdered fuel. Is it not necessary to show the actual cost of cleaning, repairs, and maintenance of brickwork done on each? The chief should be able to see that the cost of repairs to those boilers having auto-stokers is perhaps three times as much as for the hand-fired boilers, or that repairs to brickwork on those consuming oil or powdered fuel may be a very serious item. Again, perhaps turbines (and the necessary auxiliaries) by different makers are installed. Comparative costs of repairs and maintenance of each set should be available, not only for the sake of keeping a tight hold of costs, but also for future guidance.

At the present day, works costs are a very serious item indeed, and I think should be so arranged that the chief can at any time see all spots of enlarged, increasing, or unnecessary expenditure, so that the necessary steps may immediately be taken at the time those spots appear, to check their growth.

J. H. Whyman.

London.
January 18th, 1921.

The Constitution of the National Council.

I attended on Thursday last, January 20th, a joint conference of representatives of the District Councils and the National Industrial Council for the Electricity Supply Industry, and was a very interested observer, not joining in the discussions.

The principal item upon the employers' agenda was the question of the constitution of the National Council. This occupied some time, and eventually the proposals submitted were defeated, not, I believe, because the trade union delegates from the various District Councils were against direct representation upon the National Council, but mainly because the principle had not been discussed by the District Councils, and I would ask for this matter to be seriously considered by them.

On this question of principle I am definitely at one with the employers' representatives, as I think that both sides of the National Council should be drawn from the representatives of the various District Councils, thus co-ordinating each district and providing the members of the National Council with full information of what exactly is being done in each district. The question of numbers could be settled afterwards; what I am concerned about is the principle involved.

There is no doubt that the present National Council is an anomaly, and as far as the District Councils are concerned, entirely undemocratic. On the other hand, nothing could make the present Whitley scheme more constructively sound than to join up all the various District Councils in one body, resulting in a National Council directly representative of each District Council, to say nothing of the intelligent interest created in the District Councils in having one of their number to see the job right through.

At present each District Council makes recommendations and then is left quite in the dark until the arbitrary verdict of the absolute and independent National Council arrives, the National Council on its own side being equally in the dark as to the general tone of feeling in the District Councils except as much as can be conveyed by correspondence.

There for the moment I will leave it, but I would express the wish that the subject shall be considered by the District Councils, and a vote on the question be taken, and representations made to the National Council as to their wishes in the matter.

We had, too, the amusing experience of a chief engineer moving a resolution to the effect that the wireman's rate of wages was too high. He was supported by other chief engineers, amongst whom I noted one who is employed by a Labour Council in London. I am wondering if he was voicing the opinion of his Council, and shall certainly have to take steps to see that a resolution is tabled before his Electricity Committee about his rate of wage, which I think is certainly excessive, whatever he may think about the wiremen's. The resolution was not carried, not that it would have made any difference if it had, but we certainly know some of our friends. Look out for reprisals!

The Conference generally was a step forward, but I trust that next time the agenda will be prepared and submitted to both sides some days before the conference takes place.

W. J. Webb,
Secretary of Trade Union Side of Nos. 9 and 10 Areas D.J.I.C.'s for the Electricity Supply Industry.

London.
January 24th, 1921.

[An article on this subject appears elsewhere in this issue.—Eds. Elec. Rev.]

German Competition in the Electrical Trade.

The twin subjects of German competition and unemployment and their relation one to the other are naturally very much to the fore just now.

The question for decision is: "Is it right or wise and in the interests of the nation as a whole that we should purchase freely German manufactured goods?"

In endeavouring to find an answer to this question, there are, to my mind, two things to be first considered:—

1. Germany's object in dumping these goods on us, and
2. The present conditions which make it possible for her to do so.

(1) Most of us know what Germany's object was, and still is, and those who don't know will find out by reference to your leading article.

With regard to (2), we have to remember that Germany didn't win the war, at least we are told that she didn't (how she would have dealt with competition if she had won may be left to the imagination, but it is more than likely she would have dealt with it on the lines of the boy with the apple—"there wouldn't have been no competition").

Not having won, however, and being taxed, therefore, at about half the rate we Britishers are, she finds the rate of exchange so much in her favour that she is able to dump her manufactured goods on us at a price below our cost of production, and she no doubt sees visions of being able at one fell swoop to accomplish that which before the war took her many years of effort and sacrifice.

I shall, no doubt, be reminded that Germany has a big load of debt to carry. True, but you can't pay and owe as well, and as Mr. Allam has pointed out in his very able letter,

Germany has no intention of paying; but if she does eventually pay, and has in the mean time been able to get the control of the electrical industry, which she has, I believe, set out for, we might easily be worse off than we were before the war.

How far this German competition increases unemployment I am unable to say, but it cannot be denied that it is responsible for some of the increase in unemployment. If it be a fact that at the commencement of the present trade slump the British manufacturers of electrical accessories had not more than sufficient business in hand to keep their workpeople fully employed, then it follows that every order given to Germany for this class of goods creates or increases unemployment in this country.

If German competition is as good a thing as some people try to make out, by all means let us foster it, even if by doing so we become merely a nation of shopkeepers; but let us do so with our eyes open, remembering, as Mr. Allam says, what happened during the war, and how many of our lads paid the penalty of the folly we should propose to perpetuate. It would be as well also not to shut our ears to the, at present, comparatively quiet cry of our own unemployed.

The question, as one of your correspondents remarks, "calls for clear thinking and action."

T. Gladdy.

Birmingham.
January 18th, 1921.

Reliable Electric Irons.

Our attention has been drawn to the account of the performance of an electric iron as reported in your January 7th issue. This is most interesting, but the performance is, of course, only a repetition of many such which have occurred accidentally. We have known instances of an iron burning a hole through an expensive table, and, not satisfied with that, falling on to the floor, and commencing to make its way into the apartment underneath. In one such case, the contractor claimed it as a triumph for his flex, and considered the iron had done no more than he expected it to do.

Most types of modern electric irons would, of course, stand more than this, but the notice referred to reminds us of a series of tests we made some years ago on our "Smoothwell" irons to determine the best form of element.

One of the irons, No. 602, 6 lb. weight, 485 W, was switched on the Birmingham 220-V mains on January 22nd, 1912, and taken off in July, 1913. During this period the iron was in circuit night and day, except that on every week day it was switched off for one hour to prove our claim that the "Premier" waved wire element is not strained by alternate heating and cooling. This alternate test is, of course, much more severe on the iron generally than a continuous one.

By the end of the period, the iron had been in circuit well over 12,000 hours, and had consumed 6,000 B.O.T. units, and as it was still in perfect electrical order, it was thought unnecessary to go to any further expense on energy in the effort to break it down.

The face of the iron showed a dull red glow in the dark, and it was often used as a cigar lighter, for which purpose it was quite efficient, but it also scorched one's face at the same time.

We might mention that two other irons of the same type as the above, but with elements made in different ways, lasted 2,509 hours and 482 hours respectively.

Premier Electric Heaters, Ltd.

Birmingham.
January 21st, 1921.

A Generator Problem.

Referring to "Wireman's" sketch, the machine appears to be a simple compound wound generator, with separately excited shunt field. I imagine the "compound winding" referred to by "Wireman," in his previous correspondence, is the "series winding." I would suggest that "Wireman" test the polarity of his field coils to ascertain if they are alternatively N. and S., and at the same time make certain that the series coils are not opposing the shunt. This may be done with a pocket compass, the generator being run, first, as a shunt machine (with the series coils disconnected), and then as a series machine with an exterior load, and shunt coils disconnected. Should any alteration be necessary, care should be taken when reconnecting to the supply, to keep the direction of current through the shunt circuit the same as when testing. On the other hand, a "drop test" on the field coils and armature may reveal a fault which prevents the machine from delivering the rated output.

C. A. Besley.

Cardiff.
January 22nd, 1921.

Shop Displays.

I am surprised at the personal abuse by Mr. Tate in your issue of the 14th inst. If this is the only assistance he can give to electrical shopkeepers in their endeavour to get protection against the unfair methods of the wholesalers and lamp firms, we prefer to be without it. As he writes as the secretary of the E.C.A., I presume the Executive of the Association are the sponsors.

I certainly had hoped the E.C.A. would have come into the correspondence with the desire to help, but events prove differently.

During the last few weeks I have called on some electrical shops, and only in one instance did I find the shopkeeper had been a member of the E.C.A., but had resigned some years back, as the benefit he derived was an occasional book.

The E.C.A. claims to be a useful body, and doubtless it is, but judging from the tone of the secretary's letter, the shopkeeper is not for its consideration; perhaps Mr. Tate would give the number, if not the names, of the electrical shopkeepers who are on the Executive, and also the dates of the meetings when matters are discussed, as is done by other trade bodies.

Mr. Tate's paragraph re the public is entirely wrong, as how the public are concerned in a matter which appears only in the trade journal is beyond my comprehension.

We shopkeepers want an Electrical Shopkeepers' Alliance, and now is the moment; the wholesalers are employing travellers to call on hotels and other large users to filch the trade that should come to them through us; something must be done, or we may find it necessary to assist the foreigner, in order to attain protection.

Retailer.

January 20th, 1921.

P.S.—It seems very evident from the discussion that there are many unfair things done to injure retailers of electrical goods, and that the trade requires organisation to put it on an equal basis with other retail trades. Will those interested write to me, care of the Editors, so that an informal discussion can be held on the matter with a view to taking steps to improve the position?

Referring to the letter of Mr. Cohen, of Messrs. Watson, Marsh & Co. (Hampstead), Ltd., I do not think it necessary to reply to the inaccuracies contained in the same, except to state that amongst many letters received from his firm, I notice one dated September 10th, 1919, which contains the following words:—

"We desire to thank you for your courtesy and *attention* in the several matters dealt with."

Readers will draw their own deductions from the tone of his letters as to the value of Mr. Cohen's repudiations.

Leonard G. Tate,
General Secretary,
Electrical Contractors' Association (Inc.).

London.
January 25th, 1921.

Home Lighting Economies.

Two of your correspondents refer to my recent warning against the fire risk incurred in the connection of 6-volt shunt circuits (with "6-volt" insulation) to a 250-volt or even a 100-volt house installation, and point to the success of their own economy circuits and freedom from accident. The installations of "W. H. R." and Mr. Fowler Clark differ, however, in an important detail from that described by "Voltman"; for while they have taken the precaution of connecting the bell-push and the cotton-covered wiring to the pole which is normally at earth potential, "Voltman" has connected his at a switch, and switches are (or should be) in the outer or unearthed wire.

But the so-called "neutral" of a three-wire system is by no means always at or near the earth potential; in some systems the negative line is normally earthed, and in most others the full voltage of one side is found occasionally between the neutral and earth. "W. H. R.'s" fuses (which it is hoped are of the 250-volt pattern) may afford some protection, but as they will be virtually in parallel when they are subjected to an earth current, the value of this protection must be discounted.

"W. H. R.'s" diagram does not indicate whether it is possible to break the S.P. main connection at the neutral; if so, and there is an earth on the bell, &c., circuit, the whole of the main current will take this earth and *none of the fuses will be blown*, the current being limited to normal by the high-voltage lamps and other consuming devices.

Mr. Fowler Clark mentions the additional risk of the accumulator terminals, and I think enough has been said to justify my warning, that any conductor which is connected to a lighting circuit is liable in ordinary use to be subjected to the maximum pressure on that circuit, and that such conductors should therefore be treated accordingly as regards situation, insulation, and protection. In practice, I believe that this necessity will be found to counteract the economy, and that the true economy, without the risk, is more likely to be found in Mr. Fowler Clark's suggestion for series running.

E. R.

January 24th, 1921.

Indicating Wattmeter in Remote Position.

Can any of your readers suggest the least costly method of solving the following problem?

"A" and "B" are two generating stations situated about two miles apart. The owners of "A" have contracted with the owners of "B" to take a supply of electrical energy amounting to from 300 kW to 400 kW, on the three-phase system at 6,600 volts, 50 periods.

About half-way between "A" and "B" it is proposed to loop the main cable (only one cable is to be laid) into a sub-station within the area supplied by the owners of "A," from which a demand of 100 kW may have to be met, so that the supply to be taken will be delivered in part to the intermediate sub-station and the remainder to station "A."

It is required to provide means for giving a continuous indication at "A" of the total demand in kilowatts being made by system "A" upon generating station "B."

How can this best be done?

January 22nd, 1921. **Inquirer.**

Charging Batteries for Motor Cars.

I have recently been investigating various methods employed in motor garages for charging accumulators, and I have not yet come across a single system which is efficient or flexible.

In an ordinary garage there are usually 10 to 12 batteries on charge, and these batteries are usually 6, 8, and 12 V. It is not efficient to charge all these batteries in series, as they usually all require different charging rates, as for instance, new cells will require a prolonged charge at about 4 A, while the cells which have been in operation for some time may take from 10 to 12 A.

I am anxious to know if any other correspondents can advise me of some firm which makes charging boards with the resistance so arranged as to give different charging rates. These boards could be used either in conjunction with a motor generator set, or else with a d.c. supply from the town mains.

I am sure if anyone got out such a standard set, it would be taken up by all the up-to-date garages.

January 19th, 1921. **Rootes Ltd.**

Terminal Glands that ought not to be used in Connection with Electric Furnaces.

All who have Glover's interesting calendar see before them, for the remainder of this week, photographs of an atrocity in the design of an electrical joint.

The problem is to connect 24 37/12's from transformer to furnace.

The castings are out of all proportion to the work they are called on to do; and, if water colling is necessary, the water has to come and return through flexible pipe.

The pictures clearly show that the weight is not hung on the bars so as to avoid uselessly damaging twisting stresses. Compare the size of the flange joint with the size of the connection to the three bars in the same circuit.

The other ends of these particular flexibles have no such casting to crush them out of reasonable shape, and no water cooling device, and are no larger than the connection at the end of the bars.

Surely there is no necessity for such absence of thought in design.

Theodore Stevens.

London.
January 20th, 1921.

[Some letters have been held over.—EDS. ELEC. REV.]

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Tandem Resistance.

It is the practice in every modern kinema theatre to-day to install at least two bioscope machines, the object being to change over from one film to another with as little delay as possible, and by the installation of a tandem resistance in circuit with the two arcs, the change over in current from one arc to the other is hardly perceptible as the current is transferred or regulated from one machine to the other without any break in the picture. The current is graduated to produce a dissolving effect on the screen during the change over. The tandem resistance also prevents overloading the generator. A new type of resistance, fig. 1, introduced by MESSRS. AUSTIN WALTERS & SON, of Gaythorn Works, Little Peter Street, Manchester, has several advantages over the fixed brush contact type, by having each contact brush adjustable, so that the gradual change-over can be obtained without having to first bring the regulator over to the *full* current stud (unless actually working on full output), and to bring the other section of the regulator on the corresponding low current stud on the other resistance, which is necessary on the fixed brush type. In this resistance each section of the regulator is adjustable and interlocking, so that whatever the actual working current, the adjustment can be made instantly to regulate either arc to obtain a gradual, smooth change-over. In the event of the motor generator failing, it is necessary in the majority of cases, unless a duplicate set is installed, to change over on to the corporation or supply company's pressure, which is usually 400 or 500 volts, through a large resistance frame. The

FIG. 1.—A NEW TANDEM RESISTANCE.

tandem resistance is left in circuit, but the one section being used on the arc is cut out. This has to be done alternately on each machine as used, otherwise the finer wire section of the tandem resistance would be burnt out. This contingency is provided for by the ability to put the regulator into such a position that both parts of the tandem resistance are practically cut out.

A "Mechanical Fuse."

The accompanying sketch, fig. 2, shows, diagrammatically, the arrangement of a "mechanical fuse" used on a very large plate mill of the latest design in Canada. A is the main mill motor shaft carrying the flywheel, and continuing on to the pinion housing; B is the outer bearing at motor end of shaft; C is a crosshead free to move endwise but normally held by the two tie bolts E; D is a bracket machined to permit the crosshead C to move in an endwise direction only. In the event of breakage of the portion of the main shaft adjacent

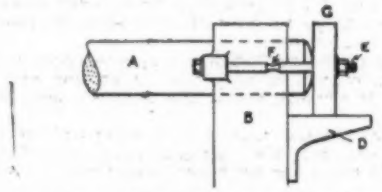

FIG. 2.—SAFETY DEVICE ON MILL SHAFT.

to the pinion housing and of the fracture following the usual diagonal form, a heavy end thrust is put upon the main shaft, which causes the fracture of the "fuse" bolts, at the reduced portion shown at F on the sketch; this permits the shaft to move endwise sufficiently for the fractured ends to clear each other, so saving additional damage due to the momentum of the flywheel and rotor. At the same time the endwise movement operates a switch cutting off the supply of current to the motor. The amount of end movement is limited by a collar on the main shaft, which is not ordinarily in contact with the face of the bearing.

Strange Radium Stories.—The *Berliner Tageblatt* narrates a curious history of certain dealings in radium, according to the *Observer*. It is noteworthy that during the war and after the war, the stock of radium in Germany was greatly lessened, and it is regarded as certain that in the form of radium, whole fortunes were conveyed abroad and concealed. When in the years 1917 and 1918 the sun of war profiteering was at its zenith, a demand for radium arose which was even greater than that for platinum and gold. Offers to buy "at highest prices" were to be found in quantities in medical and other professional publications. For many doctors and researchers who had got into difficulties owing to the rapid fall in the value of money it was a great temptation to acquire a large fortune by a legal sale of the radium in their possession, and this, indeed, appears to have been done to a large extent.

BUSINESS NOTES.

Bankruptcy Proceedings.—*Re* Sydney Aston Mersey Rose, 79, Elgin Mansions, W., electrical engineer.—At the London Bankruptcy Court, on January 18th, the bankrupt applied to Mr. Registrar Mellor for an order of discharge from bankruptcy proceedings instituted by a creditor in October, 1913. Mr. Walter Boyle, Official Receiver, reported that the provable debts amounted to £2,014, whilst the assets, valued by the bankrupt at £2,553, had only realised £12. The applicant, when a child, was taken from this country to Australia, and there eventually became an electrical engineer in Melbourne, where he contracted a debt of several thousands of pounds to a Mrs. Oitner, who had financed his business. In 1907 he left Mrs. Oitner in charge of the business and returned to England to dispose of his interest in a patent electrical self-registering device which he had invented for recording hits on a rifle target. He first sold his rights for £2,000 in shares to a syndicate, which resold to a company for £17,000, but as subscription failed, the company went into voluntary liquidation, and in February, 1912, he purchased the patent from the liquidator for £100, but only received £35. The bankrupt next secured the services of an outside stockbroker, Mr. W. H. Tottie, who procured the promotion and flotation in March, 1912, of the Rose Automatic Target Co., Ltd., with a nominal capital of £35,000, to which he (bankrupt) sold the British and Colonial rights and 30 per cent. of the foreign rights for £2,000 cash and £14,000 in shares; he had received £500 cash, the balance being absorbed in Mr. Tottie's expenses and remuneration, and his shares were divided between Mr. Tottie and his company promoters, certain disappointed shareholders of the defunct company, his wife, and his personal creditors. The bankrupt acted as technical adviser to the company from March to June, 1913, when, owing to disputes with the company, his services came to an end. The company was still in existence. The bankrupt attributed his failure to lack of income and the long delay in floating his patent as a successful undertaking. The only offence reported was the insufficiency of assets to equal 10s. in the £ on the amount of the liabilities, and the discharge was granted subject to a suspension of three months.

I. J. Hodson and B. H. Newman (Hodson & Newman), electrical engineers, 85, Queen Street, Exeter.—First and final dividend of 4s. 2½d. in the £, payable, February 4th, at the Official Receiver's office, 9, Bedford Circus, Exeter.

W. Drysdale, electrician, 24, Paxton Street, Barrow-in-Furness. Receiving order made January 14th, on debtor's own petition. First meeting, January 26th. Public examination, February 11th, both at Barrow.

J. S. Denley (Denley & Co.), electrician and cycle dealer, 69, Regent Street, Cheltenham.—Receiving order made January 17th, on debtor's own petition. First meeting, February 3rd; public examination, February 3rd; both at Cheltenham.

J. W. Gladwin, electrical engineer, 81, Burcot Road, and 1A, Meersbrook Park Road, Sheffield.—Receiving order made on January 21st, on debtor's own petition.

G. F. Kiveron, electrical engineer, late of 38, Shrewsbury Road, Sheffield.—Last day for proofs for dividend, February 9th. Trustee, Mr. L. C. Johnson, Official Receiver's Offices, Figtree Lane, Sheffield.

Company Liquidations.—Llanrwst Electricity Supply Co., Ltd.—A petition for the winding up has been presented to the County Court of Carnarvonshire, by Mr. P. Dawe, of 11, Banister Road, Southampton, and will be heard by the Court at Blaenau Festiniog on February 15th.

W. S. Laycock, Ltd.—A petition for the winding up has been presented by Messrs. Bagshawe & Co., Ltd., of Dunstable Works, Dunstable, and Mr. C. H. Beauchamp, trading as the Thornton Equipment Co., of Peventon, Rettendon Common, Chelmsford, and will be heard by the High Court on February 1st.

Leyburn Electric Supply Co., Ltd.—Winding up voluntarily, owing to the sale of the company to Mr. P. Dobson, of Leyburn, who has been appointed liquidator.

Peel-Conner Telephone Works, Ltd.—Winding up voluntarily. Liquidator, Mr. J. Fraser, 31, Copthall Avenue, E.C. A meeting of creditors was called for January 26th.

Dissolutions of Partnership.—Bailey & Smart, electrical engineers, 17 and 19, Cross Street, Oldham.—Mr. E. J. Bailey and Mr. W. N. Smart have dissolved partnership. Mr. W. N. Smart will attend to debts.

Johnson & Ridsdale, electrical engineers, 27, Upper North Street, Leeds.—Messrs. C. W. Johnson and J. C. Ridsdale have dissolved partnership. Debts, &c., of the late firm will be paid by Mr. Johnson, who is carrying on the business under his own name.

Trade Announcements.—Messrs. Ward & Goldstone, Ltd., have removed into their new premises at Frederick Road, Pendleton, Manchester, and all communications should now be addressed there. New telephone numbers:—"442 to 447 Pendleton" (private branch exchange).

Messrs. G. S. Peckham & Co., 4 and 5, New Compton Street, Charing Cross Road, London, W.C. 2, have been appointed London and South of England agents for the Reliance Lift and Engineering Co., Ltd., of Sentinel Ironworks, Bradford, for the sale of their passenger and goods lifts, &c.

The Hatcham Manufacturing Co., Ltd., 314, Gray's Inn Road, W.C. 1, has now an additional telephone line—"Museum 5895."

Messrs. R. B. Hand & Co., Ltd., 63, High Holborn, W.C. 1, have been appointed sole distributing agents for the British Isles for Messrs. R. G. Haskins Co., of Chicago, specialising in labour-saving devices, such as portable electrical drills, grinders, &c.

Messrs. Higgs & Hill, Ltd., of South Lambeth Road, S.W. 8, having learned that a rumour is afoot to the effect that their electrical engineering department is about to be closed, inform us that such a statement is wholly unfounded. They are busy with many important contracts for the Government and private clients, fully maintaining their prestige as electrical engineers in the building trade.

Messrs. Electrical Utilities, Ltd., of London, have appointed Mr. A. C. Borthwick as their representative for the whole of Scotland. Inquiries should be addressed to him at 149, St. Vincent Street, Glasgow (Telephone, Central 1126).

Messrs. A. Hartley & Co. have commenced business as electrical engineers at 37, Standish Street, Burnley, and they desire to receive priced catalogues and lists of all classes of electrical goods.

Catalogues and Lists.—Midland Dynamo Co., Ltd., 64, Belgrave Gate, Leicester.—Two fully-detailed and priced stock-lists of "Parkinson" and "Brook" a.c. motors.

Messrs. Burton, Griffiths & Co., Ltd., Ludgate Square, Ludgate Hill, E.C. 4.—An illustrated and priced leaflet of "R.G.L." stocks and dies; also a leaflet illustrating "Columbian" sledge-tested vices.

Messrs. Alfred Herbert, Ltd., Coventry.—A booklet containing grinding-wheel selection charts to aid in the choice of proper material for specific work.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—An illustrated and priced leaflet dealing with "Hart" high-pressure accumulator batteries.

The Aster Engineering Co. (1913), Ltd., Wembley, Middlesex.—A number of leaflets dealing with "Aster" engines and generators for all purposes—house-lighting, welding, pumping, transport, &c. The pamphlets are fully illustrated, and price-lists are also supplied.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Installation Leaflet No. P 2,322: "Colliery Electrification," an illustrated description of a fan and haulage installation at a Durham colliery.

Messrs. R. O'Brien & Co., 66, Mosley Street, Manchester.—An artistically-produced catalogue of "Luna" glass-lighting fittings of many types; also a separate price list of these.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—Stock-lists of two and three-phase induction motors—squirrel-cage and slip-ring; priced.

The Westinghouse Morse Co., Ltd., Letchworth, Herts.—An illustrated catalogue (W. M. 121) showing the construction and principles of the Westinghouse Morse rocker-joint chain drive. The details are lucidly explained, and prices of standard types are given.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2. List No. 314.—A catalogue of domestic electrical cooking and heating apparatus, illustrating and describing irons, kettles, cookers, toasters, vacuum cleaners, &c. List No. 316:—"High efficiency lighting," a well-illustrated booklet of reflectors, lanterns and fittings for gasfilled lamps. Both lists are fully priced.

Messrs. Malcolm & Allan, Ltd., Goschen Buildings, 12, Henrietta Street, Strand, W.C. 2.—Stock lists of d.c. and a.c. motors, giving full particulars.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—"The Electrical Link," the first number of a little publication which is to be published monthly with the object of assisting dealers in "Universal" electrical appliances. Various points regarding these appliances are picked out for emphasis by salesmen.

Catalogues Wanted.—Messrs. Whitakers (Engineers), Ltd., of Horsforth, Leeds, wish to receive catalogues from makers of crane motors and switchgear.

Messrs. Reginald Long & Partners, consulting engineers and factory equipment specialists, of 19, Southampton Buildings, Chancery Lane, W.C. 2, wish to receive catalogues and price lists from manufacturers of electrical and mechanical apparatus.

The Public Works Department, Kenya Colony, are desirous of receiving catalogues dealing with the electrical and mechanical trades. For particulars, see our advertisement pages to-day.

German Contracts.—This note, taken from the Toronto *Electrical News*, speaks for itself:—

"'Contracts worth £200,000 have recently gone to a German firm of electrical machinery manufacturers because their prices were so much lower than those of their English rivals.'

"The above item appeared in a Toronto evening paper, and, though probably unintentionally, it gives the impression that this refers to a Canadian purchase. As a matter of fact, it is taken from an English paper, and has reference to equipment bought there. This is bad enough, as it is a bad example for the Mother Country to be setting her children, but presumably they know their own business best over there. The point we are anxious to emphasise, however, is that it was not a Canadian order that was given to a German firm, and it will probably be some time yet before we shall consider it in the best interests of the Empire to follow such a course."

Book Notices.—"Contact," the Journal of the National Association of Supervising Electricians. Vol. II, No. 3.—The January issue includes a commentary on the settlement of the Penistone dispute, "The Development of Telephone Switching," "Progress in Lighting" (illustrated), &c.

"Wireless Telegraphy and Telephony." By L. B. Turner. Pp. x + 195, figs. 119. Price 20s. net. Cambridge: University Press.

"The English Electric Journal." Vol. I, No. 5. Pp. 56.—Included in this number of the journal are a description of the Willans Works, Rugby (illustrated), "Electricity in the Tin Industry" (illustrated), "Fuses," &c.

"The Metropolitan-Vickers Gazette." Vol. V, No. 93. Pp. 23.—The December issue contains articles on "The Individual Drive and Control of Machine Tools" (illustrated), "Non-Stranded Copper Conductors for C.C. and A.C. Service," with curves, and an illustrated description of a rotary converter installation at the Summer Lane Station of the Birmingham Corporation.

"Modern High-Speed Influence Machines." By V. E. Johnson. Pp. viii + 278, figs. 93. London: E. & F. N. Spon, Ltd. Price 14s. net.

"Winning the Public." By S. M. Kennedy. Pp. vi + 168; five illustrations. Price 15s. "The Thermionic Valve." By H. J. Van Der Bijl. Pp. xx + 392; 232 figs. Price 30s. London: McGraw-Hill Publishing Co.

"Memoirs of the College of Science, Kyoto Imperial University." Vol. III, No. 11; Vol. IV, Nos. 1 to 6. Kyoto: The University. Vol. IV, No. 3, includes a paper on "Brush and Glow Discharges of Electricity and the Formation of Spark"; No. 4 contains a number of papers on the electrical study of the structure of various elements; and No. 6 includes "Electrolytic Reduction of Monthone."

"De la Suisse à la Mer." Edition Spéciale de la revue "Schweizerland." September, 1920.—This special issue (in French) is devoted exclusively to the discussion of schemes for the opening up of the Rhine and other rivers to Swiss commerce, and the institution of a direct economic exchange between London and Basle. Mr. Gelpke deals with the subject from the technical point of view. The development of waterways towards Italy is discussed by Dr. Rusca, and navigation on the Rhône is presented by M. Savoie-Petitpierre. In addition to this, we have received a translation of Mr. Gelpke's article, and also two translated reprints of articles by the same author dealing with the navigation of the Rhine. This literature may be obtained through the Swiss Legation, 32, Queen Anne Street, Cavenish Square, W. 1.

"Cheap Steam." Vol. V, No. 1. January, 1921. Little Hulton, Bolton: Ed. Bennis & Co., Ltd. 1s., post free.—Included in this issue are articles upon "Induced Draught Fans," "Corrosion of Economiser Tubes," "Safe Storage of Coal," &c.

"Exact Data on the Performance of Steam Boiler Plants, No, 4, Average Figures for the Performance of some Different Types of Steam Boilers. By David Brownlie, B.Sc., &c. Reprinted from *Engineering* (14 pp.). London: Brownlie & Green. Ltd. Price 2s.

Branch Factories Overseas.—The question of setting up branch factories in the Overseas Dominions and in foreign countries has been discussed in these columns on various occasions in the past. Attention has been drawn particularly to the advantages of this policy with regard to Canada, where United States manufacturers are securing a strong footing behind the tariff wall. The fact must be faced that the new countries overseas, British and otherwise, are more and more taking up the idea of establishing their own manufacturing industries, and while the old-established industries of Great Britain need not doubt their capacity to hold their own against the newcomers, it is, perhaps, as well to recognise the value of establishing branches on the spot, so as to get in during the early stages of local development. A Perth (Western Australia) correspondent of *The Times Trade Supplement* refers to the fact that the "Australian Producers' Wholesale Federation" has just set up an office in London. During his visit to this country its representative approached Bradford spinners with a view to persuading them to establish branches in the Commonwealth. It is stated that a well-known manufacturer will visit Western Australia and confer with the Government on the question of starting the industry in the State.—*Bulletin* of the F.B.I.

A Social Club.—MR. W. M. WILLIAMSON, who recently held a very fine Electrical Exhibition at Electric House, 184, Peckham Rye, as reported in our columns, has given his old premises at 104, Peckham Rye, to his workmen for a Social Club. The premises are his own freehold, and his action shows a spirit of good fellowship which is worthy of imitation. The premises were opened by the brothers Williamson on Monday last, and between 40 and 50 of the employés were present. An excellent programme had been arranged by Mr. Milne. The premises consist of card-room, committee room, billiard room, and reading room, and facilities for refreshment have been provided. The firm has furnished the premises throughout, and provided a billiard-table, card-tables, &c. Mr. A. H. Harris is secretary, and the working committee is composed of members of the outside staff.

Rubber Growers' Association Competition.—We are informed that the result of the prize competition promoted by the Rubber Growers' Association (Inc.), of London, for ideas and suggestions for extending uses,—or encouraging new uses, for rubber, which closed on December 31st, 1920, will not be known for some three or six months, dependent on the amount of experimental work necessary. It is interesting to note that over 2,000 entries have been received by the chartered accountants who were entrusted with the audit of the scheme, and it is hoped that valuable results may be obtained.

Calendar.—THE SUNBEAM ELECTRIC CO., of 63, Lancaster Avenue, Manchester, has sent us a wall calendar. A coloured print shows the surrender of the German Fleet (November 21st, 1918), monthly date slips for 1921 appearing below it.

Lead.—MESSRS. G. CAWSON & CO., reporting under date January 22nd, state:—"The consumptive demand shows no improvement, although electrical works are buying to cover their prompt and also forward requirements. They evidently look on prices as favourable."

MESSRS. JAMES FORSTER & CO. say:—"Consumers have bought very little, and that only for immediate wants; there has been no business for export to speak of, and speculation for the time being is having a rest. On the other hand, available imports this month are so far inadequate to meet pressing demands, so much so, that actual trade requirements have had to be supplied from warehouse, and such lead as is expected to arrive this month is already earmarked. Our experience is that not a few consumers are very short of supplies."

British Industries Fair.—*The Times* states that during the British Industries Fair, to be held at the White City from February 21st to March 4th, a number of official foreign commercial missions will be invited to England. These missions will be drawn from various European and other neighbouring countries, and will consist, in some cases, of the Ministers of Commerce, and in all cases of representatives of important commercial organisations. They will visit the Fairs at London and Birmingham.

The Sun Company's Dinner.—To celebrate the firm's "coming of age," the directors of the SUN ELECTRICAL CO., LTD., entertained their staff and agents to dinner at the Holborn Restaurant on January 22nd, Mr. A. G. Beaver, managing director, occupied the chair, and the dinner was an excellent one in every respect, all arrangements being admirably carried out.

After dinner a number of vocalists and entertainers provided a programme in which art and humour were very evenly balanced. Signor Sanda, who was received with enthusiasm, rendered numbers from *Rigoletto* and *I Pagliacci*, and Mr. Arthur Hill displayed talents in a number of directions, ventriloquial and otherwise. Space, unfortunately, forbids a detailed account of the other items, which were all very good.

The toast list commenced, of course, with "The King." Mr. W. J. Rogers, secretary, proposed the toast of "The Directors" in a speech which praised their efforts and their personalities. Mr. W. R. Rawlings, in reply, facetiously stated that the secretary had hardly done justice to his (Mr. Rawlings's) good points, but, at the same time, hadn't dwelt too long on his bad ones. Mr. R. Tweedy Smith, who also replied, referred to the tightness of money and the circumstances under which a great number of firms had been forced to liquidate their stocks at considerable loss. The Sun Co. had bought cautiously, and did not intend to be caught in the general catastrophe.

Mr. A. G. Beaver, in proposing "The Staff and Agents," recalled the very early days of the company, when the staff was a small one of about a dozen members. To-day there were about 150, and they were not stopping at that figure. He spoke of the acquisition of the Charing Cross Road premises, and announced that negotiations had been completed with Messrs. Crosse & Blackwell for the purchase of property at the rear of those premises. A considerable sum of money was to be spent in adapting these to the needs of the company. Mr. Beaver referred to the versatility of Mr. Morton, who had aided the firm in several totally different ways. Mr. C. H. Phillips responded for the staff in a brief but witty speech. Major Huxley, on behalf of the agents, said that an agent's lot was not a happy one, but much encouragement was to be derived from the "Sun" calendar, with its more or less appropriate texts.

Mr. E. R. Morton proposed the toast of "The Press," and said that the recent agitation for the publication of net sales statistics had shown up the electrical Press in a very favourable light, and some of the figures had surprised him. Mr. J. H. Cosens briefly responded.

Mr. H. C. Weekes is to be congratulated on his management of affairs. The Press, instead of sitting in splendid isolation, had the pleasure of the company of a number of the ladies of the staff.

Land Values Duties.—Mr. W. R. Fairbrother, income-tax specialist, writes to point out that under the Finance Act, 1920, all the assessments to Land Values Duties that have been made under the Finance (1909-10) Act, 1910, have been discharged, and where duties have been paid already under any such assessments such duties can be recovered if a claim is made within six calendar months of the passing of the 1920 Act. This period will expire on February 4th next, so that all claims should strictly be in before the end of the present month. The various duties which can be recovered are as follows:—Increment Value Duty (including annual Increment Value Duty), Reversion Duty and Undeveloped Land Duty imposed by Part I of the Finance (1909-10) Act, 1910, but do not include Mineral Rights Duty.

Review of 1920.—The Federation of British Industries has issued a Financial Review of 1920, in which are included useful tables and curves showing the fluctuations in the rates of foreign exchange and the price movements of the raw materials of industry. It has been prepared by Messrs. J. S. M. Ward, B.A., F.S.S., and N. E. Crump, F.S.S.

New Belgian Company.—La Société de la Centrale Electrique de la Vallée de la Houille is the name of a new company which has lately been formed in Brussels, with a capital of 1,000,000 fr.

Tramway Industry Court of Inquiry.—The Secretary of the Ministry of Labour announces that arrangements have been made for the Court of Inquiry in connection with the wages dispute in the tramway industry to be held at St. Ermin's Hotel, Caxton Street, Westminster, S.W. 1. The inquiry opened on Wednesday, January 26th, at 10.30 a.m., and was held in public.

For Sale.—Farnworth Urban District Council invites offers for one two-flued Lancashire boiler, feed pumps, &c.; Messrs. Eadon & Lockwood will offer by auction, on March 8th and following days, at H.M. Factory, Langwith, Derbyshire, chemical and electrical power plant and engineers' tools, electrical and other stores, &c.; by direction of the Disposal Board, Ministry of Munitions, Messrs. Eadon & Lockwood will sell by auction, on February 15th, 16th and 17th, at the R.A.O.D., Chilwell, Notts., about 1,350 miles of electric wire and cable, cab-tire cable, instrument and telephone wire, also generating sets, &c.; Messrs. Bradshaw, Brown & Co. will sell by auction, on March 1st and following days, at H.M. Stores (Depôt 303), Wallis Road, Hackney Wick, N.E., a quantity of plant and machinery, including d.c. motors, ammeters, voltmeters, and various electrical sundries. For particulars, see our advertisement pages to-day.

Battersea Borough Council Electricity Department invites offers for two Parsons turbines, complete with ejector condenser, each coupled to a Parsons 750-kW d.c. generator; and one Willans engine, with condenser, coupled to a Mather & Platt 324-kW d.c. generator. Brighton Corporation Electricity Department has for disposal one triple-expansion Willans engine, direct-coupled to a Crompton 440-kW multipolar dynamo; also two engines of similar type, but without dynamos.

Electric Testing Apparatus for Garage Use.—MESSRS. HEWLETTS, LTD., of Parker Street Works, Hucknall, near Nottingham, have recently brought out two sets of apparatus specially designed for the use of motor-garage proprietors who undertake magneto repairs and remagnetising. One of the sets takes the form of a portable magnetiser to be used in conjunction with a 4-V accumulator. The polarity of the magnets is found by holding the magnet near the coils of the instrument and pressing a button; if the magnet is drawn towards the coils, it may be inserted in that position, but if repelled, it must be reversed. With the magnets in the coil, the button is pressed repeatedly for a few seconds. Special pole-pieces are used when the magnets are of unusual size, the pieces being placed inside the coils and the magnet put on them, when the same procedure is gone through.

The second set consists of a special apparatus for testing for faults in high and low-tension windings, magnetos, armatures, slip-rings, sparking plugs, &c. By means of this instrument, in which a 4-V accumulator is also used, a magneto can be thoroughly tested without dismantling. If there is no spark, or only a feeble one, the magneto is taken down, when each part can be tested individually. Coils can only be checked for faults, and, provided the very complete instructions which are issued by the makers are followed, there should be no risk of failure or damage.

A B.T.-H. Dinner.—The annual dinner of the B.T.-H. Co. Testing Department will be held on February 18th, Mr. A. S. Kettle in the chair. The committee trusts that all past members of the department will endeavour to attend. Application for tickets (10s. 6d. approximately) should be sent to Mr. A. V. Scratchley, c/o Testing Department, B.T.-H. Co., Rugby.

Advertising by Film.—EDUCATIONAL FILMS CO., LTD., 76, Wardour Street, London, W. 1, call our attention to a method of advertising which has as yet been used only in a very restricted way, but which has great possibilities, and is especially applicable to a business which appeals to a special buyer rather than to the general public; this is advertisement by means of the film. For all manner of machinery the film is unexcelled as an advertising and selling medium. Details of construction and motion can be studied and explained by the film sometimes better than by the actual machine itself. The use of animated diagrams is particularly valuable in this respect.

The great difficulty hitherto experienced has been for the manufacturer to show the film to a public he wishes to reach. Private projecting theatres have been established in 12 of the largest industrial towns in the British Isles. When the film is once made, copies can be reproduced very cheaply, and if one of these is deposited in each of the towns, it can be shown at the convenience of the prospective buyer. For instance, a representative in Glasgow could arrange, at his convenience, for one or a dozen buyers to see the film. In very many cases it is impossible for a representative to carry with him the actual machine he wishes to sell; yet, armed with a portable projector and a film, he can show on any office wall, and in any country, a moving picture which will bring out more clearly than any explanation of his, the work, advantages, and selling points of the machine in which he is interested.

German Canals.—A decision has been reached that the canals of all the German States shall come under the control of the Central Government as from April 1st of this year, thereby fulfilling the provisions of the German Constitution that all means of communication shall be controlled by the Empire.—*The Times.*

Annual Dinner.—The annual dinner of the staff of MESSRS. RASHLEIGH PHIPPS & CO., LTD., 147, Oxford Street, W., took place on Saturday evening last at "The Feathers," Westminster, under the chairmanship of the founder of the firm. There was a large attendance, and the subsequent entertainment provided by "home talent" resulted in a most enjoyable evening.

Trade Disputes.—The total number of trade disputes, involving stoppages of work, reported as beginning in December, was 34. In addition, 65 disputes which began before December were still in progress at the beginning of that month. The total number of workpeople involved in all disputes in progress in December was about 72,000, as compared with 1,138,000 in the previous month (when about 1,100,000 workpeople were on strike in the coal-mining industry) and 110,000 in December, 1919. Of the total number involved, the majority were accounted for by two disputes, one affecting 45,000 coal miners in the Rhondda district, who stopped work with a view to securing the reinstatement of certain workpeople who had been discharged, and the other affecting 10,000 workpeople in shipyards throughout Great Britain, owing to a strike of joiners and carpenters against a proposed reduction in wages. The estimated aggregate duration of all disputes during the month was about 429,000 working days, as compared with 3,631,000 days in November, 1920, when the coal strike was in progress, and 1,808,000 days in December, 1919, when iron-founders in most districts were on strike throughout the month.—*Morning Post.*

Inquiries.—The makers of the "Klimax" parallel arc for lantern and kinema purposes are asked for. A reader asks for the maker's name, or where he can find a technical description, of an instrument suitable for measuring and recording atmospheric electricity. The names of manufacturers of ironclad switchgear bearing the mark D. E. W. inside a diamond, are asked for.

American Trade with Germany.—The monthly statement of the Department of Commerce shows that American trade with Germany continues to increase. Exports in November were valued at $35,061,009, as compared with $23,044,142 in the same month a year ago, while imports from Germany totalled $7,557,688, as compared with $3,212,831 in November, 1919.—*Reuter's Trade Service* (Washington).

German Activity in Montevideo. — Engineer Arent, Councillor in the Ministry of Posts, Telegraphs, and Telephones of Germany, arrived at Montevideo at the end of 1920, in the course of a tour he is making of the South American Continent for the purpose of obtaining information regarding telegraph and telephone working in the principal cities. The Uruguayan Postal authorities are offering every facility to Herr Arent.—*Review of the River Plate.*

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of productions connected with the electrical trades and industries:—

Persephone. No. 409,164. Class 8. Telephones and telephonic apparatus. Thos. Macready Down, 65, Gloucester Road, Kew Gardens, S.W. October 27th, 1920.

Limpet (lettering and design). No. 408,369. Class 13. Magnetic hand lamps. John Tweedie, trading as Wm. Barton & Sons, 11, Forrest Road, Edinburgh. October 2nd, 1920.

Ozon. No. 408,677. Class 13. Electric lamps (ordinary). Wm. Lennard, 3, Love Lane, Eastcheap, London, E.C. October 13th, 1920.

Star and Tree (design). No. 408,535. Class 50. Electrical accessories made of wood. Otto F. Ahlmann, ET, 35, St. John Street, London, E.C. October 8th, 1920.

Westinghouse (lettering and design). No. 407,700. Class 8. Secondary batteries. Westinghouse Union Battery Co., Swissvale, Penn., U.S.A. September 8th, 1920.

Pantostat. No. 409,390. Class 8. Electric transformers. Wm. E. Schall, trading as Schall & Son, 71 and 75, New Cavendish Street, London, W. October 3rd, 1920.

Dormo. No. 408,481. Class 6. Electric motors and dynamos. Arthur A. Lyon, trading as Arthur Lyon & Co., 36, Victoria Street, Westminster, S.W. October 7th, 1920.

T.M.C. (lettering and designs). No. 409,425. Class 13. Trembler blades for ignition coils and tungsten contacts. Tungsten Manufacturing Co., Ltd., Thanet House, 231-2, Strand, London, W.C. October 22nd, 1920.

Eclair (lettering and design). No. 407,148. Class 50. Insulating materials and preparations for electrical purposes. John W. Shaw, Ltd., 90, Broughton Lane, Strangeways, Manchester. August 21st, 1920.

Brussels Patent Office.—A central Patent Office is to be set up at Brussels for the registration of patent applications, supply of copies of patents, and other like services. The Belgian capital has been chosen, as it is the seat of the International Bibliographical Institute, with an extensive library and perfect organisation. The Allied countries only may make use of the office.

The Swiss Electrical Industry.—The Swiss electrical industry is stated to be at the present time very prosperous, especially with regard to the Spanish market. A Swiss house has just secured an order from the Sociedad Productora de Fuerzas Motrices, which is a branch of the Energia Electrica de Cataluna, for the supply complete of two hydro-electric installations for the central stations which that company is now engaged in equipping.

New Belgian Companies.—There has been formed at Antwerp the Société l'Electro Moteur, with a capital of 1,200,000 fr., for the manufacture of dynamos, motors, and electric elevators. Its offices are at 237, Chaussée Saint Bernard.

Under the style of Société Continentale de l'Accumulateur Edison, a company has been embodied at Brussels (79, Rue Royale) with a capital of 1,200,000 fr.

LIGHTING AND POWER NOTES.

Accrington.—SUPPLY DELAYED.—At Church Council, on January 20th, complaints were made that, although Accrington had signed an agreement to supply electricity, nothing had been done for five months. The chairman said there was difficulty in obtaining the requisite materials, and the Accrington electrical engineer was not to blame in the matter.

Australia.—SYDNEY.—At a meeting of the City Council it was stated that unless increased rates were sanctioned by the Government, the loss on the working of the electricity department would reach £200,000 in 12 months. The city electrical engineer said that new plant and buildings, costing about £530,000, were required. It was agreed to proceed with the ordering of the new plant.

WATER POWER.—The Electricity Committee of the Municipal Council suggests that the Government be approached with a view to reports being obtained from Messrs. de Burgh & William Corin on the proposal to establish hydro-electric works on the Colo River, with particular reference to the power available in horse-power or kilowatts, assuming—(*a*) a 24-hour demand per day; and (*b*) a 12-hour demand per day; and also the cost of providing electrical equipment for the scheme.

The Electricity Committee of the Municipal Council publishes a report by the city electrical engineer, with regard to a visit to Melbourne and Adelaide, in connection with a conference of Engineers and Managers of Electricity Supply Undertakings from different States of the Commonwealth. The engineer states that he is pleased to be able to report that the result of the conference with the members of the Postmaster-General's Department has been better than the city electrical engineer hoped. The statutory regulations of the Postmaster-General's Department affecting the crossing of telephone and telegraph lines by electricity supply wires have, in the past, been interpreted by the Postmaster-General's officers in such a way as to cause the City Council of Sydney (for instance) to spend large sums each year which, in his opinion, might have been saved without materially affecting the working of the lines. As a result of the conference it is proposed to alter the statutory regulations, and also to issue instructions to the local officers of the Postmaster-General's Department, which alterations and instructions will enable the Electricity Department to carry out the same amount of work in the way of laying services and extending mains which it is at present carrying out at a cost of several thousand pounds per annum less than it has been paying in the past.

THE KIEWA SCHEME.—The Victorian Electricity Commissioners consider that the present demand for electricity in the State does not justify any immediate action with regard to the proposed Kiewa hydro-electric scheme. Apart from this, however, they think that the whole of their attention should be devoted to the development of the Morwell scheme for the utilisation of brown coal for the generation of electricity. The Kiewa scheme, which is estimated to cost £890,000, will be a useful adjunct to the Morwell project when the latter is working.

Barrow.—WATER-POWER REPORT, &c.—The Town Council has agreed to the electrical engineer and the surveyor preparing a report upon the proposed utilisation of the River Leven at Backbarrow for the development of electricity. Should Barrow require further power immediately, Messrs. Vickers, Ltd., can supply it from their new power station at Buccleuch Dock. A confidential report was considered, last week, upon the financial aspect of developing the town's electrical undertaking, prepared by the treasurer. It was decided to become a member of the joint electricity authority for the district, the Corporation representatives to report upon developments to the Council before committing it to any schemes entailing financial obligations.

Bingley.—BULK SUPPLY AWARD.—Mr. S. E. Fedden, City electrical engineer, Sheffield, was recently appointed to investigate the complaint of the Bingley Council that the bulk supply from Keighley Corporation was inefficient, and that the agreement was not being carried out satisfactorily. In his award Mr. Fedden says that after hearing both parties he has come to the following conclusions:—The interruptions and breakdowns have been mainly due to neglect on the part of the Keighley Electricity Department, and only in a lesser degree to that of the Bingley Electricity Department. The Keighley Corporation has not done everything reasonably possible to restore the supply after the occurrence of an interruption or breakdown. The costs of the arbitration are to be borne to the extent of four-fifths by Keighley, and the remainder by Bingley.

Birmingham.—REPORT ON EXTENSIONS.—In view of the Council's decision at the last meeting to defer placing the contracts for the large extension scheme approved on June 8th last, until the general financial position has improved, the Electric Supply Committee has presented a report to the Council, confining its investigation to the question of devising temporary measures to mitigate the adverse effect of delaying the larger extensions.

There are three directions in which the Committee now seeks the authority of the Council to proceed, on the understanding that the cost of doing so is defrayed temporarily from the department's internal resources until such time as it is possible for the Finance Committee to report that capital funds are available, viz.:—

1. It is proposed to install a 5,000-kW turbo-alternator set, with condensing plant, switchgear, foundations, water-tube boilers with the necessary economisers, chimneys, &c., the approximate cost of which would be £120,000. This plant would be installed in the building now under construction at Nechells.

2. A sum of £30,000 is urgently required for normal extensions of the distribution system, to which to a large extent the department is already committed. These extensions of mains are works that proceed from week to week as part of the ordinary development of the undertaking, and are necessary in order to make supplies of electrical energy from the new generating plant available in those portions of the district where they are required.

3. The third portion of the work to proceed with which authority is now sought is that of piling the ground for the foundations for the deferred building extension. This work of piling takes considerable time, and is, of course, an essential preliminary to the building extension. The estimated cost of doing it now is £20,000, and the Committee advises that its execution at the present time will avoid a delay of approximately six months when the time comes for proceeding with the extension scheme as a whole.

The total estimated cost of these works is thus £170,000, of which sum £108,000 forms part of the large extension sanctioned by the Council last June. The Committee recommends that it be authorised to proceed forthwith with the works referred to.

Blackburn.—NEW STATION.—The action of the Corporation in facilitating the laying of mains from the new generating station at Whitebirk, in order to find employment for men out of work, will considerably hasten the scheme, and it is expected that before next winter both Great Harwood and Rishton will have a supply of electricity. Some delay may be occasioned in obtaining the necessary cable, but when this is available the work will be pushed forward. Considerable progress is being made with the construction of the buildings, the erection of which was commenced in May of last year.

Continental.—RUSSIA.—A Berlin message states that the Soviet Government has promulgated a decree that all persons under 55 years of age who have had experience in cable works, electric lamp factories, power stations, &c., are to be mobilised. The avowed object of the decree is to proceed with the previously-announced electrification of the country.

HOLLAND.—The proposed scheme for the full electrification of the Province of Limburg is estimated to cost Fl. 1,350,000. The intention is to run an overhead high-voltage line from a power station to be erected near the "Emma" State coal mine to another station in the Swalmen district. The undertaking will probably be carried out under the same conditions as the Hoensbroek-Maastricht line, which supplies South Limburg, the State granting a concession to the province, which will entrust the carrying-out and working of the scheme to the Stroomverkoop Maatschappij. A heavier cable, however, will be used and the distance between the standards will be increased to 250 m. The route will be from the Emma Mine, through Amstenrade, Oersbeek, Schinnen, Mundengeleen, Sittard, Broek-Sittard, Nieuwstad Susteren, Echt, Maasbracht, Montfort, Linne, St. Odelierberg, Melich Herchenbosch, and Maasneel, to Swalmen.—*Economic Review.*

JUGO-SLAVIA.—Efforts are being made to develop manufacturing industries, and considerable activity is noticeable in various centres. In this connection the American Consul at Belgrade states that the hydro-electric plant at Zelina Vir, Croatia, is nearly completed. The buildings have all been constructed, and the machines are actually *en route*. The plant, at high water, will furnish 2,000 h.p., and at low water about 1,200 h.p., and will be able to supply power for the lighting of all the towns and villages of the *arrondissement* of Gorski, and still have reserve power for industrial purposes.

The Société Industrielle de Sminje, Dalmatia, which was formed in 1916 in order to utilise the water power of the Cettina river, which is estimated at 30,000 h.p., is now continuing its work, which was interrupted by the war. It is expected that the plant will soon be in full operation.

Dover.—KENTISH COAL.—The calorific value of the Kentish coal supplied to the electricity works is stated by the electrical engineer to be 15 per cent. above that of the Yorkshire coal usually employed. A special underfeed stoker is necessary, however, but a saving of over £115 has been effected in four weeks.

Dundalk.—EXTENSIONS.—Mr. P. A. Spalding, electrical engineer to the Urban Council, in his report on the proposed extension of buildings and plant, at an estimated cost of £30,000, points out that, while present conditions are against such a scheme, the work must be undertaken with the least possible delay. A considerable proportion of the new output will be required to satisfy the greatly-increased demand of the Great Northern Railway (Ireland) local works, and it is reasonable to assume that the railway company will contribute a due share towards the proposed capital outlay. The highest figure calculated gives a price of approximately 2·5d. per unit. Mr. Spalding does not think, having regard to the high costs, that the company would consider 2½d. per unit excessive, especially as 1·8d. per unit was agreed to for the year 1919, when the average price of fuel oil was less than £7 per ton, as against £12 now. There is, the report adds, still plenty of scope for electrical development in Dundalk, mostly for power and heating purposes.

Electricity Districts.—NORTH-WEST MIDLANDS.—The Electricity Commissioners have extended the period for the receipt of representations regarding this district to March 31st next.

SOUTH-WEST MIDLANDS.—The time for the receipt of representations regarding this district has been extended from Jan. 31st to March 31st.

At a Conference of Worcestershire authorities, last week, in regard to proposals concerning the formation of an electricity area, Mr. Willis Bund (Chairman of the County Council) said he was told that the Commissioners did not intend to allow, except in exceptional circumstances, any schemes to be set up in the areas they had mapped out. He thought they should ask the Commissioners if they were likely to assent to the formation of a separate area in a part of the proposed South-West Midlands area. Evesham, Droitwich, Malvern, and Pershore intimated that they did not support the Worcester proposal. It was agreed to make the inquiry on the lines suggested.

LONDON AND HOME COUNTIES.—The local inquiry which is to be held in connection with the provisionally delimited London and Home Counties Electricity District is to take place in June next.

Godmanchester.—HYDRO-ELECTRIC SCHEME ABANDONED.—On the ground of the cost being prohibitive, the Town Council has declined to consider a proposal to utilise the water power from the old mill race for the purpose of generating electricity.

Iceland.—HYDRO-ELECTRIC SURVEY.—A message from Reykjavik to the *Berlingske Tidende* says that the Islandske Ingenioer-Forening has requested the Government and the Alting to institute investigations with regard to the possibility of establishing an industry in Iceland, using the waterfalls as the motive power. The construction of a railway to the south part of the island is also recommended, and the Government is also asked to appoint a commission to go into the matter. The Forening also requests the Government to receive eventual applications for a concession to construct a large hydro-electric station.—*Reuter's Trade Service* (Copenhagen).

Ilkley.—EXTENSIONS.—The Council is applying to the Electricity Commissioners for a reconsideration of their decision with regard to extensions some time ago. The Council received sanction to install a 170-kW set, but desired also to extend the power-station buildings to permit of the early installation of an additional 200-kW set. The Commissioners refused to sanction this, and suggested that any further power required should be obtained from Keighley Corporation. Inquiries made it evident that a bulk supply from Keighley would be more costly than the installation of new generating plant, and the Electricity Commissioners are being informed of this.

Larne.—BATTERY ROOM DESTROYED.—A battery room forming part of the power station of the Larne Electric Light and Power Co. has been destroyed by fire. From these batteries the local shipyards derived their supply. The building was a wooden erection, and the damage to the battery is estimated at £20,000.

Leeds.—WORK FOR UNEMPLOYED.—Various schemes are suggested for providing work for the unemployed, the necessary Government approval and grants having been applied for in each case by the General Purposes Committee of the Corporation. The schemes include a proposal for extensions of electricity mains. There is yet no definite scheme in this matter, but the Electricity Committee has signified its preparedness to expedite main laying in order to absorb labour.

Llandudno.—BULK SUPPLY.—The Electricity Committee has been instructed to negotiate with the North Wales Power Co. for a bulk supply to Llandudno. The Power Co.'s scheme to be presented to the Electricity Commissioners has received the Council's approval.

London.—ST. MARYLEBONE.—The Electric Supply Committee recommends that the special rate of 1½d. per unit charged for all electricity supplied to St. Dunstan's Hostel for blinded soldiers and sailors, Regent's Park, be increased to 2d. per unit. It is stated that the consumption at the Hostel amounts to 100,000 units per annum.

BATTERSEA.—The agreement for a bulk supply of electricity from the Fulham Borough Council, made in 1915, contained clauses relating to fluctuations in the price of coal, but no provision was made for wages increases. In these conditions the Fulham Borough Council has forwarded a claim for £2,600 to the Battersea Electricity Committee. The Committee recommends that Fulham be offered £750.

WOOLWICH.—The Electricity Commissioners have written to the London County Council stating that a scheme of extensions, estimated to cost in the aggregate £230,000, has been submitted by the Woolwich Borough Council for approval. The immediate work to be undertaken will cost £60,000, the new plant comprising a 5,000-kW turbo-alternator with condensing plant, and a 33,000-V feeder cable to Erith, &c. The letter asks if the London County Council has any observations to offer regarding the sanctioning of a loan of £60,000. The Finance Committee recommends that the following reply be sent to the Commissioners:—From the point of view of the general financial position of the borough, the application of the Woolwich Metropolitan Borough Council for sanction to the borrowing of such a large sum as £230,000 for electricity purposes is a matter for serious consideration by the Electricity Commissioners, and that the Council, while expressing no opinion as to the merits of the scheme, assumes that the Commissioners are satisfied that the expenditure to be incurred will result in an early improvement in the present unsatisfactory financial condition of the undertaking; that the Council is of opinion that the debt outstanding upon any superseded plant should be repaid, and the Borough Council required to enter into an arrangement with the London County Council with regard to the liquidation of any loans outstanding on any plant which is to be superseded by reason of the further extension of plant now proposed to be sanctioned by the Commissioners on similar lines to the arrangement previously made with the Borough Council.

Mexborough.—BULK SUPPLY.—The Urban Council has decided to accept the terms for a bulk supply of power from the Yorkshire Electric Power Co. An alternative proposal to ask Rotherham Corporation for a bulk supply was withdrawn.

Newmill.—LIGHTING SCHEME ABANDONED.—In view of the difficulties encountered in connection with the proposed electric light scheme, the Urban District Council has decided to abandon the project.

New Zealand.—TAUMARUNUI SCHEME.—H.M. Trade Commissioner at Wellington has informed the Department of Overseas Trade that the Borough Council of Taumarunui, a rising township on the main trunk line from Wellington to Auckland, has recently adopted a proposal to develop electrical energy from the Wanganui River for use for power and lighting purposes. The works are estimated to cost £44,000, and a poll of ratepayers is to be taken as soon as possible to secure powers to raise a loan for the purpose.

Portsmouth.—LOAN SANCTIONED.—The Electric Light Committee has received the sanction of the Electricity Commissioners to a loan of £91,000 for additional plant, &c.

Rochdale.—LOAN.—The Town Council has been recommended by the Gas and Electricity Committees to apply for sanction to the borrowing of £106,000 to meet the cost of installing plant to deal with the bulk supply of electricity from the Lancashire Electric Power Co. About a third of this amount has already been spent. The remainder is required for work already authorised, such as the installation of transformers and other arrangements for distribution.

Skegness.—ELECTRICITY SUPPLY SCHEME.—Mr. C. H. Wordingham's report on an electricity supply scheme for the town was discussed by the Council on January 13th. The report gave the total cost of an installation as £44,500, with annual capital charges amounting to £4,070. It was stated that a profit of about £100 per annum could be expected from a total revenue of £6,600. A member of the Council pointed out that at the present time there were 11 small private installations in the town, but the owners of these were ready to dismantle them if a town supply became available. The Council finally decided to apply for a further extension of the time allowed for the carrying out of the compulsory provisions of the Lighting Order.

Southend-on-Sea.—PROPOSED EXTENSIONS.—The Town Council is to consider at a special meeting a scheme for extending the plant at the electricity works, at an estimated cost of £300,000.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—ELECTRICITY WORKS RAILWAY.—The Town Council is applying for a provisional order to enable it to construct a street railway between the electricity works and the Caledonian railway. The Aberdeen Harbour Board is of the opinion that such an order would prejudicially affect its interests and requires modification. In order to secure a *locus standi* in the matter, a formal objection is being lodged by the Board.

Australia.—MELBOURNE.—The electrification of the Melbourne suburban railways was commenced in 1912, and it was stated that the work would be completed by 1917. As the electrification is still proceeding, the Railway Commissioners have been subjected to a great deal of criticism. They point out, however, that the outbreak of war completely disorganised a number of important contracts, and material had thereby been held up. Two large generators are still awaited for the Newport power station, and in addition to these, the equipment for ten or more sub-stations has not yet been delivered. Commenting upon this, the Melbourne *Age* says:—"It can no longer be pleaded that the British manufacturers are unable to undertake the work; business is so dull with them that they are dismissing their hands; and even if it were otherwise, a great deal of the work could be undertaken in Australia. During the two years that have passed since the close of the war, very little progress has been made. The completion of the scheme is already three years overdue, and at the present rate of progress a further three years is almost certain to elapse before the public will receive the services they were led to believe would be available for them in 1917."

Barnoldswick.—ORDER CANCELLED.—As no definite progress has been made with the construction of a light railway between Barnoldswick and Gisburn, it has been removed from the Light Railway Commissioners' list.—*Lancashire Post.*

Belfast.—NEW CARS, &C.—Eight of the new tramcars ordered by the Belfast Corporation have now arrived in the city, and have been put into commission on the ordinary service. Fifty cars are being purchased, and it is expected that the whole of them will be delivered within the next six months. In accordance with the resolution passed at the last monthly meeting of the Corporation, application has been made to the Ministry of Transport for permission to increase the minimum fare to 2d., but the authority for making this change has not yet been received. Although the proposal is to fix the minimum fare at 1½d., there is a possibility that in the near future the charge will be increased to 2d. A large deficit is anticipated at the end of the present financial year, and

in addition to that, the Corporation is faced by a heavy outlay on the reconstruction of the tramway track, which has received very little attention during the last six years, owing to the call for economy during the war and since. It is estimated that this work, if carried out all over the system, would cost about £2,000,000.

Birmingham. — RAILLESS SYSTEM INVESTIGATION. — Faced with the prospect of heavy expenditure on the renewal of the track of the tramways, the Corporation has sent a deputation to Bradford to see the railless trolley car system in operation there.

Continental.—FRANCE.—The Société des Transports en Commune de la Region Parisienne, which has been granted a concession for the working of the various surface tramway undertakings expropriated by the Council of the Departement de la Seine as from January 1st, 1921, recently offered for subscription 120,000 shares of 500 fr., composing the capital of the company. The concession is for a period of 30 years, although the Council has the option every six years of taking over the combined undertaking on giving two years' notice.

Halifax.—CONTROL OF TRAMWAYS.—The matter of the control of the Halifax tramways, which has excited keen controversy between the Tramways Committee and the Town Council, and has led to the resignations of the chairman and vice-chairman of the Tramways Committee and the chairman of the Tramways Sub-Committee, does not seem to be quite settled even yet. Although the Town Council, after a former rejection, eventually accepted only one of the three recommendations of the Committee —that of transferring control of the tramway track from the Highways Committee to the Tramways Committee—further delay is promised now in meeting the urgent need for track renewal by a resolution passed by the Highways Committee, on January 17th, recommending that the transfer of control should not take place until the end of the present year.

Leeds.—DAILY DEFICIT.—The returns presented at a meeting of the Tramways Committee of the Leeds Corporation showed that during last month there was still an average deficit of £49 per day on this undertaking, which shows a substantial decrease on the loss of £111 per day for the nine months ended December 29th last. The total deficit for this latter period was £30,495, representing a loss of nearly 1d. per car-mile. The question of again increasing the fares, which was considered at the last meeting of the Committee, was again discussed, and it was finally decided to hold the matter over.—*Leeds Mercury.*

Metropolitan Railway Co.—The Minister of Transport has extended the times of the Metropolitan Railway Acts of 1911, 1912, and 1913, for the completion of certain railways, until August, 1922.

Salford.—TRAMWAY PASSES ILLEGAL.—The Tramways Committee has rescinded its resolution to grant free travelling passes to members of the Council, the town clerk having expressed the opinion that the resolution is illegal.—*Daily Dispatch.*

South Shields.—NEW CARS.—Five new double-decked electric cars have been delivered by the English Electric Co., Ltd., of Preston, to the Corporation. Each vehicle accommodates 82 passengers, and will cost £3,300.

TELEGRAPH AND TELEPHONE NOTES.

Cuba.—NEW TELEPHONE CABLES.—Direct telephonic communication between the United States and Cuba is to be provided by the Cuban-American Telephone and Telegraph Co., a permit for the landing of three telephone cables from Havana at Key West (Florida) having been granted the company on January 4th, by the State Department. The laying of the cables is expected to be completed in the Spring, and they will be approximately 100 miles in length, or longer than any submarine telephone cables yet laid. Of the three talking circuits to be provided, one will be connected directly with New York. A second circuit will pass through the Jacksonville (Flo.) central office for service to Western States, and the third will connect the Key West exchange for calls to and from points in the south. The construction of the cables, already completed, presented entirely new engineering problems, due to the depth of the waters to be traversed.—*Reuter's Trade Service* (Washington).

Foreign Telegrams.— RATE REVISION.—It is announced in the *London Gazette* that the rates per word for telegrams to the undermentioned places are now as shown below :—Timor (Dilly), 4s. 1d.; Chatham Islands, 3s. 2d.; Makatea Island (Pomoton Archipelago), 4s. 8d.; Greece, 6d.; Greek Islands (except Corfu, Crete, Euboea, and Poros, 6d.), 6½d.

Imperial Telegraphy.—A deputation representing the Newspaper Proprietors' Association, the Newspaper Conference, the Empire Press Union, and the Press Agencies, waited upon the Postmaster-General (Mr. A. H. Illingworth), last week, to emphasise the need for improvements in communication by cable and wireless. According to the *Morning Post*, Viscount Burnham, introducing the deputation, said that Press rates for telegrams existed in name only, the deferred rate across the Atlantic was useless, there were great delays, and it was particularly desired that the wireless policy of the Government should be known. The Postmaster-General replied that good progress was being made in providing wireless communication around the British Empire. The service to Cairo it was hoped to get working by next May. That was the first part of the Imperial chain. It would go on to Nairobi, and then to Windhoek in South-West Africa, where the German station was being improved upon. India, Singapore, Hong-Kong, and Australia would be included in the circuit, and the various Dominion Governments concerned were being consulted in the matter. There would also be wireless communication with Sweden, Norway, Denmark, Germany, Poland, Czecho-Slovakia, Austria and Hungary, Jugo-Slavia, Italy, Holland, and Belgium. The Marconi Co.'s service would cover Spain, Italy, France, Nova Scotia, and New Jersey. A Committee was sitting to consider on what terms licences should be given to private enterprises. The question of providing facilities for receiving news sent by the Press from the Naval station in America provided by the United States Government was being considered. Within the Dominions the Government would control the wireless services. It was proposed that the Post Office, when given a message, should exercise the option of sending it either by wireless or cable if the method of transmission was not defined by the sender. He welcomed the formation of a Committee representative of the Press, the Stock Exchange, the Baltic Exchange, Lloyd's, and other big cable users, which would be able to consult and advise the Government.

Telephone Rates.—NEW TRUNK RATES POSTPONED.—The Post Office announced on the 24th inst. that it had been decided to defer the new rates for trunk calls from February 1st to April 1st. The new tariff does not affect anyone, except new subscribers, before April 1st; the agreements of existing subscribers are being terminated by due notice which will expire at various dates not earlier than April 1st, and there will, therefore, be full opportunity for discussion in Parliament before the new rates are applied.

United States.—CABLE DISPUTE.—The Federal Court has granted a temporary injunction against the Western Union Cable Co. from landing its Brazil-Barbadoes cable at Miami (Florida), from using three cables between Key West (Florida) and Havana for the transmission of messages between the United States and Brazil, and from splicing a line from Barbadoes to Cuba.—*Reuter's Trade Service* (New York).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shoots in connection with the reconstruction of the boiler house at Ferryhill. (January 21st.)

Algeria.—The Post and Telegraph authorities in Algiers have just invited tenders for the supply of a large quantity of high-conductivity bronze and copper wire.

Australia.— MELBOURNE.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes. Copies of the specifications can be seen at the Department of Oversea Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

March 31st. Electricity Commissioners. Plant for the Morwell power scheme. Telephone wire and pin-type insulators. (January 14th.)

ADELAIDE.—February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (January 21st.)

SYDNEY.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (See this issue.)

PERTH, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (January 21st.)

April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (See this issue.)

Belfast. — February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (See this issue.)

France.—PARIS.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Burrau, 103, Rue de Grenelle, Paris.

February 4th. The French State Railway authorities, 43, Rue de Rome, Paris.—The supply and erection of a number of low-pressure switchboards required in connection with the upkeep of train electric lighting equipments at the railway works at Batignolles, Sotteville, Rennes and Saintes. Particulars can be obtained from the Service Electrique at the above address.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h.p. switchgear. (January 21st.)

London.—L.C.C.—January 31st. Electric wiring installation at the Bethnal Green Weights and Measures Office and Coroner's Court, comprising about 87 switch points and 89 lighting points. (January 14th.)

H.M. Office of Works. February 1st. Six months' supply of switches, fuses and fuseboards. (January 21st.)

BATTERSEA.—February 9th. Electricity Department. E.h.p. and d.c. switchgear for two 450-kW converters. (See this issue.)

Lurgan.—January 29th. Urban District Council. Four-core l.p. lead-covered and armoured cables. (January 14th.)

Manchester.—February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (January 21st.)

February 15th. Tramways Committee. Tramway stores, including meters, cable, lamps, bells, insulators, &c. (See this issue.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand.—WELLINGTON.—March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme. Particulars from the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

March 5th. Government Railway Department. Two overhead travelling cranes. Specifications can be seen at the Department of Overseas Trade (Engineering Section), 35, Old Queen Street, S.W.1.

Rosyth.—January 30th. Electric lighting work at Park Road School. Deposit, £1 1s. Mr. R. H. Motion, architect, Union Bank Chambers, Dunfermline.

South Africa.—PRETORIA.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Spain.—Tenders have recently been invited by the municipal authorities of Jerez de los Caballeros (Province of Badajoz) for the concession for the supply of electricity for lighting and power purposes in the town during a period of eight years. The municipal authorities of Puente Genil (Province of Cordoba) have also called for tenders for a similar concession, the duration in this case, however, being only six years.

Uruguay.—MONTE VIDEO.—March 29th. State Power House. Single and three-phase meters. Copy of the specification (in Spanish), conditions of tender and a list of spares to be provided (also of a similar call for tenders for 500 d.c. meters for the provinces), can be seen at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches. A copy of the Spanish text and the blue prints can be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

CLOSED.

Barnes.—Urban District Council. English Electric Co., Ltd., interconnecting cables for coupling up alternator and switchboard, rotary converter, and transformer, &c.

Glasgow.—Electricity Committee. Recommended. English Electric Co., Ltd., electric battery locomotive, to be used on the railway sidings at Dalmarnock, £3,920.

Government Contracts.—New Contracts placed during December, 1920 :—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Batteries for 9-in. torches.—Ever Ready Co. (Great Britain), Ltd.
Coil winding machines.—Nevilles, Ltd.
Conduit tubing and accessories.—Barton & Sons, Ltd.; J. Birch & Sons, Ltd.; Brotherton, Ediswan Tubes & Conduits, Ltd.
Micanite and insulating materials.—Ioco Proofing Co., Ltd.; Micanite & Insulators, Ltd.; J. North Hardy & Co., Ltd.; R. Whiffen.
Motors and motor-generator set.—Brush Electrical Engineering Co., Ltd.
200-kW motor generator, &c.—W. H. Allen, Son & Co., Ltd.
Selector switchboard and panels.—Park Royal Engineering Co., Ltd.

WAR OFFICE.

Distributing boards.—General Electric Co., Ltd.
Electric lamps.—English Electric & Siemens Supplies, Ltd.; General Electric Co., Ltd.
Pack sets.—Marconi Wireless Telegraph Co.
Rotary transformers.—Newton Bros (Derby), Ltd.

AIR MINISTRY.

Electric wiring, Donibristle.—S[illegible]ixon & Sons, Ltd.
Generators.—Eversheds & Vignoles, Ltd.
Ignition vibrators.—H. W. Sulli[illegible].

POST OFFICE.

Telegraph apparatus.—Siemens Bros. & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone and Electric Co., Ltd.; Western Electric Co., Ltd.
Electric light cable.—Hackbridge Cable Co., Ltd.
Submarine cable.—Telegraph Construction & Maintenance Co., Ltd.
Telegraph and telephone cable.—Macintosh Cable Co., Ltd.; New Gutta-Percha Co., Ltd.
Condensers.—Telegraph Condenser Co., Ltd.
Earth clips.—Farmer & Co.
Cords for telephones.—Phœnix Telephone & Electric Works, Ltd.
Ducts.—Doulton & Co., Ltd.
Insulators.—Bullers, Ltd.
Indicator lamps.—General Electric Co., Ltd.
Laying conduits.—Preston-Blackpool (Section II): W. Dobson. Harrow (Headstone Road): G. J. Anderson. Hornsey (Coleridge Road): J. Abrahams, Ltd. London-Bristol-Newport (S.W. Section VI) and Manchester (Piccadilly and Newton Street, pneumatic tubes): E. E. Jeavons & Co., Ltd. North-Eastern Post Office engineering district: W. Irwin & Co. North Wales Post Office engineering district: Hodge Bros. (Contractors), Ltd. Walthamstow (Palmerton Road): W. & C. French. Wandsworth Common (Trinity Road) and Norwood (Vermont Road): J. Mowlem & Co., Ltd.
Manufacture, supply, drawing-in and jointing of cable.—Hampstead-Hendon Junction: Johnson & Phillips, Ltd. Hull-Grimsby: W. T. Glover & Co., Ltd. Paisley-Greenock: British Insulated & Helsby Cables, Ltd.
Earth plates.—Farringdon Works & H. Pontifex & Sons, Ltd.
Charging sets.—A. Lyon & Co.
Telephones.—Western Electric Co., Ltd.
Telephone exchange equipment.—Bromley and Walthamstow: Western Electric Co., Ltd. Luton: Peel-Conner Telephone Works, Ltd.; sub-contractors for batteries, Tudor Accumulator Co., Ltd., for charging sets, Crompton & Co.
Electric light wire.—Macintosh Cable Co., Ltd.
V.I.R. wire.—W. Geipel & Co., Hackbridge Cable Co., Ltd.

HIGH COMMISSIONER FOR INDIA.

Telephone apparatus.—Peel Conner Telephone Works, Ltd.
Carbon brushes.—Morgan Crucible Co., Ltd.
Cable.—General Electric Co., Ltd.; W. T. Glover & Co., Ltd.; Johnson & Phillips, Ltd.; Peel Conner Telephone Works, Ltd.
Cells.—Chloride Electrical Storage Co., Ltd.; Edison Accumulators, Ltd.
Sections for cells.—Tudor Accumulator Co.
Dynamos.—J. Stone & Co., Ltd.
Welding equipment.—Metro.-Vickers Electrical Export Co.
Electric fans.—Crompton & Co., Ltd.; General Electric Co., Ltd.; J. Stone & Co., Ltd.; Veritys, Ltd.
Fuses.—W. T. Henley's Telegraph Works Co., Ltd.
Generating sets, &c.—Lancashire Dynamo & Motor Co., Ltd.
Lamp holders.—Edison Swan Electrical Co., Ltd.
Meters.—Reason Manufacturing Co., Ltd.
Protectors, &c.—Peel Conner Telephone Works, Ltd.
Salammoniac.—Brunner, Mond & Co., Ltd.
Switchboards.—Kartret Engineering Co., Ltd.; Peel Conner Telephone Works, Ltd.
Copper wire.—T. Bolton & Sons, Ltd.; W. T. Glover & Co., Ltd.; London Electric Wire Co. & Smiths, Ltd.
Iron wire.—Dorman, Long & Co., Ltd.; R. Johnson & Nephew; Rylands Bros.; Whitecross Co., Ltd.
Fuse wires.—General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Battery.—Premier Accumulator Co.
Battery materials.—Siemens Bros. & Co., Ltd.
Cable.—W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.
Cable joint boxes.—W. T. Henley's Telegraph Works Co., Ltd.
Electric light fittings.—Chloride Electrical Storage Co., Ltd.
Electric light fittings for train.—Mather & Platt, Ltd.
Electric welding plant.—Metro.-Vickers Electric Export Co., Ltd.
Insulators.—Bullers, Ltd.
Joint boxes.—Siemens Bros. & Co., Ltd.
Lamps.—Edison Swan Electric Co., Ltd.
Telegraph ironwork.—Siemens Bros. & Co., Ltd.
Telegraph line material.—Bullers, Ltd.; Siemens Bros. & Co., Ltd
Telephone materials.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone sets.—Peel-Conner Telephone Works, Ltd.
Insulated wire.—Hooper's Telegraph & India-Rubber Works, Ltd.
H.D. copper wire.—R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd

DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND.

Electric lighting work at the Department's Ulster Dairy School, Cookstown.—Ferguson & Bruty, Ltd.

PUBLIC WORKS, DUBLIN.

Belfast.—Plumbing, gasfitting and electrical works and supplies: A. Stevenson.

London.—L.C.C. Establishment Committee. Electric motors required in connection with the electrical work at the new County Hall :—

Crompton & Co., Ltd. (accepted)	**£10,231**
Veritys, Ltd.	11,094
Electromotors, Ltd.	12,254
General Electric Co., Ltd.	14,985

Newport.—ISLE OF WIGHT.—Town Council. Isle of Wight Electric Light Co.—Electric light installation, new houses, from £11 1s. to £14 17s. per house.

St. Dunstan's Massage Clinic.—We have received from the authorities of St. Dunstan's Hostel for Blinded Soldiers and Sailors particulars of a massage clinic recently opened at 18, Christopher Street, Finsbury Square, E.C. 2. Everything is managed on the most modern lines, the equipment including faradic, galvanic, radiant heat and other apparatus. The efficiency of the *masseurs*, who are all blinded soldiers, with a sighted *masseuse* in charge, is vouched for by a number of eminent medical men. We are also informed that many blinded soldier *masseurs* have set up clinics of their own in various parts of London; a list of these is obtainable from St. Dunstan's.

A Kinema Improvement.—Captain Raymond Phillips, who was in charge of the inspection of optical instruments and range-finders in the Irish military command during the war, has invented a new means of projecting kinema pictures. He gave a *Daily Mail* representative a demonstration of his method of stereoscopic projection recently. Projecting moving pictures in the ordinary way, he makes them zig-zag on to a series of specially-prepared mirrors and through a prism before they reach the screen. In this way pictures become markedly more detailed and less "blurry"; 2 ft. to 3 ft. "deeper," and steadier.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, January 28th. At the Philosophical Institute. At 8 p.m. Papers on "Electrical Wonders in Guernsey," by Mr. E. C. Catford.

Physical Society of London.—Friday, January 28th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Association of Engineers-in-Charge.—Saturday, January 29th. At St. Bride's Institute, Bride Lane, E.C. At 7 p.m. Discussion on "The Association and its Future Activities." To be opened by Mr. A. E. Penn.

Manchester Association of Engineers.—Saturday, January 29th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Cast Iron v. Semi-Steel," by Mr. E. Wheeler.

Institution of Electrical Engineers.—Informal Meeting.—Monday, January 31st. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Possible Economies in House Wiring." To be opened by Mr. L. Milne.

(East Midland Sub-Centre).—Tuesday, February 1st. At the Technical College, Derby. At 7 p.m. Paper on "Recent Developments in Wireless Telegraphy and Telephony," by Mr. W. O. Ridley.

Manchester Wireless Society.—Wednesday, February 2nd. At 7.30 p.m. Paper on "The History of the Telephone," by Mr. A. Marr.

Paisley Association of Engineers.—Wednesday, February 2nd. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Wireless Telegraphy and Telephony," by Mr. D. McKay.

Royal Society of Arts.—Wednesday, February 2nd. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Oil Burning Methods in Various Parts of the World," by Mr. A. P. Baillie.

Chemical Society.—Thursday, February 3rd. At Burlington House, Piccadilly, W. At 8 p.m. Informal meeting.

Chelmsford Engineering Society.—Thursday, February 3rd. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Some Useful Metal-testing Machines," by Mr. H. S. Primrose.

Royal Institution of Great Britain.—Friday, February 4th. At Albemarle Street, W.1. At 9 p.m. Lecture on "The Electrical Expression of Human Emotion," by Dr. A. D. Waller, F.R.S.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the ELECTRICAL REVIEW is now ready, and will be supplied for 6d., post free, on application to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C. 4.

Cheap Power.—A correspondent to *Power* recently drew attention to a circular issued by a "wind motor" company. This would appear to be another of those schemes for obtaining power for nothing which crop up every now and again. The idea is to employ the natural draught given by a 250-ft. chimney shaft to drive an air turbine fixed in the base of the shaft. To meet with any quota of success the draught would surely have to be an "unnatural" one. The correspondent states that a recent test showed the output of the turbine (11 ft. in diameter) to be 47 h.p. at 80 r.p.m., but he adds: "I was fortunate enough to meet a man who happened to see the test, and he informed me that there was a briak coke fire burning in the base of the stack during the run."

Service Notes.—Warrant Electrician T. Barham has been appointed to the battleship *Benbow;* Warrant Electrician T. R. Hopkins to the battleship *Erin*, for group of reserve ships; Warrant Electrician W. Sweany, to Greenwich; Warrant Electrician A. C. Cornhill, to battleship *Colossus*, for group of reserve ships; Warrant Electrician J. Belcher, to the battleship *Warspite*, from the 19th inst.; Warrant Telegraphist S. W. Francis has been posted to the *Pembroke*, depôt ship at Chatham, for service with the Signal School, Chatham; Commissioned Telegraphist Walter Turnbull has been appointed to the charge of the wireless station at Ascension—the lonely island in the South Atlantic lying between the Coast of Brazil and the West Coast of Africa, 1,450 miles off the latter.

Finsbury Old Students' Association.—A dinner was held, on January 20th, at the Grand Hotel, Manchester, by a number of Old Finsbury Students, for the purpose of forming a local section of the Finsbury Technical College Old Students' Association. Mr. Eustace Thomas occupied the chair, and was supported by Prof. Miles Walker, Messrs. A. P. M. Fleming, A. G. Livesay, Linch, and other prominent local old students. After the dinner and the formal business of establishing the section, a short musical programme was rendered. The Hon. Local Secretary is Mr. H. F. Coucher, 9, Cartwright Road, Chorlton-cum-Hardy.

Automobile Exhibition at Basle.—An International Automobile Exhibition is to be held at Basle from May 28th to June 8th. The Committee of Organisation has sent us a booklet of rules and regulations in connection with the Exhibition. We note that a total area of 20,000 sq. metres has been taken over by the Basle section of the Swiss Automobile Club, and exhibits are to be classified under nine heads, including passenger and touring automobiles, lorries, motor cycles, accessories, &c. The booklet and further details may be obtained from the Swiss Legation, 32, Queen Anne Street, Cavendish Square, W.

Electrolytic Copper Production in Sweden.—Some weeks ago we referred to the situation of the A. B. Elektrolytverken, which company was formed in 1918 by some of the largest Swedish consumers of copper and owners of copper ore deposits, for the production of electrolytic copper, so as to meet the most pressing requirements in this respect. *Svenska Dagbladet* now announces that as it has been impossible to obtain increased guarantees for the company's loan, the shareholders have unanimously decided to liquidate the company.

The Electrical Trades Benevolent Institution.—A meeting was held at the Engineers' Club, Manchester, in December last, to discuss the advisability of forming a local Advisory Committee, at the instance of Mr. Farthing, who expressed regret at the fact that little was known in Manchester with regard to the objects of the Benevolent Institution. As the result of the discussion, a meeting was held on January 10th at which Mr. Hawes, the secretary, gave an address outlining the objects and organisation of the Institution, and the method of conducting local Advisory Committees. The meeting then elected Mr. J. A. Robertson as chairman; Mr. J. H. Farthing, vice-chairman; Mr. W. J. Smith, secretary; and Messrs. Phillips, Scott, Shaw, Walker, Quass, Hall, and Kirkham, as members of Committee. It was agreed that the representatives of local electrical associations should be added to the Committee.

As mentioned elsewhere in this issue, the Benevolent Institution is this year going to carry on an energetic campaign for the purpose of establishing the fund on a sound basis; in this the Executive Committee will be very greatly helped by the local Advisory Committees, and in view of the density of population, electrically speaking, of the Manchester area, it cannot be doubted that the new Advisory Committee will be in a position to "make things hum." We must confess to some surprise on learning that a district so important and wide-awake as this not only had no Advisory Committee, but actually knew very little about the Benevolent Institution. Now that it has come forward to bear its share of the burden, we confidently look to Manchester to put all previous achievements in the shade. Up to now the fund has with difficulty been jacked up to a beggarly £12,000 or so; we expect Manchester to put on £20,000 more in the first year, without starting a rivet or blowing a single fuse. The fund ought to pass the £50,000 mark this year, if the electrical industry does justice to its lofty ideals. Let "Service" be the watchword!

We will gladly assist the movement by all means within our power.

The Royal Air Force.—The Inspector of Recruiting, R.A.F., states that there is still a large number of vacancies in this arm of the Service for skilled men of a number of trades. The list includes electricians, wireless operators and mechanics, instrument makers, engine drivers, &c. Everything is being done to make the life attractive, and a man joining the Force will certainly not be wasting his time.

Awards for War Inventions.—According to the *Daily Chronicle*, in the first report of the Royal Commission on Awards to Inventors, just issued, it is stated that among the awards already made are the following:—

Messrs. Gwynnes, Ltd. (engines for aeroplanes) ...	£110,375
Capt. W. S. Tucker (hot wire microphone)	4,000
Lieut. R. F. Power (aerial target)	2,345
Dr. E. Prassone and Major Luigi Avorio (kite balloons)	4,500
Messrs. Sopwith (synchronising gear)...	3,950
Dr. Hele-Shaw (pneumatic clutch)	3,000
Messrs. Vandervell and Mr. A. H. Midgeley ('Allways" fuses)	14,000
Mr. H. H. R. Green (electrically-controlled switches)	7,500
Messrs. Hobson, Ltd. (carburettors)	35,031
Late Dr. E. Russell-Clarke (improvements in wireless telegraphy and aircraft devices)	8,000
Major A. C. Fuller ("Fullerphone")	3,500 & 1,250

Fatalities.—On January 19th, Henry Tonge, of Westhoughton, was going to work when he became entangled with some electric wires, dislocated during a storm, with fatal results.

A case described by the coroner as "extremely puzzling" was investigated at Palmer's Green last week. A 16-year-old schoolboy, Eric Walter Bishop, was, according to the *Evening News*, found dead in a bath at his home, and an electric heater was found in the bath. Dr. Spilsbury said death was due to syncope from disease of the heart muscles, as part of the condition of status lymphaticus. Death followed some shock, but he was unable to say what that shock was. An expert said that if the boy had been sitting in the water and dipped the heater when the current was switched on he would have had a shock, the strength of which would depend upon the conductivity of the water. He thought the chances that the boy got such a shock were very remote. The coroner returned a verdict in accordance with Dr. Spilsbury's evidence.

Exhibitions in the Netherlands East Indies, 1921.—British manufacturers and exporters who seek to develop trade in the Netherlands East Indies, should be interested in the announcement that the Second Netherlands East Indies Fair is to be held at Bandoeng (Java) from September 19th to October 9th of this year. The fair will be international in character, and will offer manufacturers an opportunity of exhibiting wares of all kinds to a vast number of potential buyers in the East. Everything that pertains to industry, commerce and agriculture will be represented at the Fair, and a Motor Vehicle and Tractor Exhibition will be held simultaneously in the same town. Preliminary arrangements are well forward, and a booklet setting forth all details is being prepared by the British Chamber of Commerce for the Netherlands East Indies, to whom, at 38, Dover Street, London, W. 1, all inquiries in connection with this Fair and the concurrent exhibition should be addressed.

Radium Ore in Madagascar.—It is announced in Paris that radium ore has been found on an island of Madagascar of such a quality that one gramme of metal can be extracted from 10 tons of ore.

Birmingham University.—The General Electric Co., Ltd., has contributed £1,000 in answer to the appeal of the University of Birmingham.

Dinner.—Portsmouth members of the Electrical Power Engineers' Association and the Electricity Supply Commercial Association held their first annual dinner at Kimbells Restaurant, last Saturday evening. About 60, including wives and friends, sat down. Mr. B. Handley, acting engineer and manager, Portsmouth Corporation Electricity Supply, presided, and was supported by Councillor A. Hemingway, of the Portsmouth Electric Lighting Committee. Visiting members from Brighton, Southampton, &c., were present. After dinner an impromptu programme of songs, toasts, &c., was contributed. Mr. P. L. Weir, acting station superintendent, Portsmouth electricity works, organised the gathering.

Appointments Vacant.—Electricity accounts and ledger clerk, for the Hackney Borough Council Electricity Department; mains foreman (116s.), for the County Borough of Newport Electricity Department; shift engineer, for the Manchester Corporation Electricity Department. (See our advertisement pages to-day.)

Overhead Arc Welding.—Mr. O. H. Eschholz, recently contributed an article to the *Electrical World* on the above subject. He states that under the extreme condition of overhead welding, when the force of gravity is opposing the transfer of metal, greater manipulative skill is required than when gravity partly or completely assists, as in vertical or downward welding. To convey the globule which forms on the end of the wire electrode to the plate, the lifting force must exceed the retaining forces of gravity, cohesion and surface tension at the wire perimeter. Gravity is diminished by keeping the globule on the electrode as small as possible. Experience has shown that the presence of iron oxide, iron carbide, manganese, &c., in the electrode decreases surface tension and cohesion. These last forces may also be diminished by the use of small diameter electrodes.

The cycle of deposition in the case of overhead welding seems to be as follows:—The metal at each terminal is liquified upon the arc being struck; the molten electrode assumes a spherical form due to surface tension; this globule is enlarged with continued application of energy until its upper surface is brought into contact with the overhead pool, thereby short-circuiting the arc stream, and causing the lifting forces to act upon it; forces of surface tension and adhesion at the contact area cause the globule to spread over the plate surface; as the metal spreads, the area in contact with the plate, and therefore the lifting forces, are increased, causing an acceleration in metal transfer; these forces act until the globule is lifted off the end of the electrode, when the short-circuit is broken, and the arc re-established.

It is preferable to select candidates for overhead work from competent downward welders. The training is graduated from vertical welding, through increasing angles, until finally the overhead position is reached. The special characteristics of the arc are fully explained, and the phenomena of metal transfer demonstrated. Overhead butt joints are prepared in a similar manner to ordinary butt joints being scarfed from 60° to 90°, with a "free distance" of from $\frac{1}{16}$ in. to $\frac{3}{32}$ in. The successful welding of an overhead butt joint is chiefly dependent upon the completeness with which the initial layer fuses together the apex of the joint.

INSTITUTION NOTES.

Institution of Electrical Engineers.—SOUTH MIDLAND TERRITORIAL CENTRE.—The annual dinner of the Centre took place at the Grand Hotel, Birmingham, on Friday last, and was very largely attended. Mr. F. Forrest, chairman of the Centre, presided. After the loyal toast, the toast of "The Institution of Electrical Engineers" was proposed by the chairman, who, speaking of the increased membership, expressed the hope that the time would come when any person who desired to attain to a position of responsibility in his profession would have to prove the soundness of his knowledge and the extent of his training by becoming a member of the Institution. In responding, Mr. Ll. B. Atkinson, president, observed that this was a "jubilee" of the Institution, in that it was the fiftieth session. The membership was over 9,000, and was larger than that of any other Institution. The increase last year was the greatest for any one year. There were more than 1,000 new students in the Institution. Could anything speak more forcefully of the confidence engineers had in electricity? The question of raising the status of engineers by some mode of registration had been raised by the Bill of the Institution of Civil Engineers last year, and would not be allowed to drop; it might be desirable to have a discussion on the subject in London. The relations between the great engineering institutions were most cordial; the time was perhaps not ripe yet for their joint accommodation in one large building, but the Institution had given a lead in the establishment of local centres, and that lead was followed by other Institutions. The question that occurred to him was whether these local Institutions might find some common roof, library, and meeting ground, so that the great expense that attached to the provision of these facilities might be shared and made easier in local centres where otherwise it might be impossible. The toast of "The Electrical Industry" was proposed by Mr. Gilbert C. Vyle (managing director, Messrs. Averys, Ltd.), who urged the importance of manufacturers and factors buying, as far as possible, in this country. He was afraid the fetish of cheapness was again gaining influence. It seemed to him utterly futile, for the sake of the difference in money value, to pay the foreigners' wages. He hoped those in this country who were placing contracts for electrical gear would look at the quality of the stuff, and not decide altogether upon the question of price. Amalgamations might do much good by specialising manufacture and reducing competition, but they must not make profits at the expense of the customer; the profits must be derived from internal economies and shared with the user. If they obtained cheap power, they would get uses for electrical gear all over the country, and he had hopes of the hydro-electric schemes coming to fruition. In reply, Mr. P. J. Pybus (joint managing director, English Electric Co., Ltd.) commented upon the slowness with which schemes for the electrification of railways were being handled in this country. It would be a great step forward if the Government, working with responsible business men, endeavoured to find some means for alleviating unemployment by undertaking really useful works.

Mr. N. B. Rosher, O.B.E., proposed "Kindred Societies and Guests," and mentioned that it was proposed to hold a joint meeting of civil, mechanical, and electrical engineers in Birmingham to discuss the Severn barrage scheme. Mr. J. D. Watson responded.

A musical entertainment followed, and brought a very successful evening to an end.

The annual dinner of the Institution will be held on March 3rd, at the Hotel Cecil, at 7 for 7.30 p.m. Mr Ll. B. Atkinson will preside.

LIVERPOOL STUDENTS' SUB-CENTRE.—A joint meeting of the Institution with the Liverpool University Engineering Society will be held on February 3rd, at 7 p.m., at the Laboratories of Applied Electricity, when Mr. J. A. Robertson, M.I.E.E., will lecture on "Lord Kelvin: His Life and Work."

STUDENTS' SECTION.—A joint visit of the North-Eastern Students' Section of the Institution of Electrical Engineers and the Junior Institution of Engineers to the Heaton Works of Messrs. C. A. Parsons & Co., Ltd., took place on January 15th. Upwards of 100 members availed themselves of the opportunity, and the tour of the works was carried out in a most thorough manner, a definite time having been allowed each party in the various shops.

Belfast Association of Engineers.—On January 27th, Mr. Richard P. Terry read a paper on "The Mechanical Handling and Conveying of Material," dealing very fully with the advantages and disadvantages of various systems.

Brighton Electric Traction and Radio Club.—This club was formed recently for the exchange of views and reading of papers upon the subjects suggested by its title. The radio section will cover "wired" telegraphy and telephony.

Liverpool Engineering Society.—At a meeting of the Society, held on January 19th, Prof. W. Mason, D.Sc., read a paper on "Impact Testing," describing a number of methods.

The Royal Institution.—On Saturday, February 12th, Prof. A. Fowler commences a course of three lectures on "Spectroscopy." The Friday evening discourse on February 4th will be delivered by Dr. A. D. Waller, on "The Electrical Expression of Human Emotion."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

THE claim of MR. A. P. RUTHERFORD, late burgh engineer at Leith, against the Edinburgh Council, is for £6,500, not £500, as stated in this column last week.

At the English Electric Co.'s Ordnance Works, Coventry, last Saturday, MR. F. H. MENCE, of the small tools department, was presented with a clock on his leaving to take up business on his own account.

Falkirk Corporation has increased the salary of the electrical engineer to £650 per annum.

Halifax Tramways Committee has accepted the resignations of the chairman (Alderman C. F. Spencer), the vice-chairman (Alderman A. Broadley), and the chairman of the Sub-Committee (Mr. R. Stirk), which were tendered recently as a protest against the Town Council's refusal, on two occasions, to accept the Tramways Committee's recommendations with regard to the appointment of a general manager. The Committee has appointed the Mayor (Alderman T. Hey) as chairman *pro tem.*, the other vacant offices being left over. The Committee decided to advertise for a general tramways manager, in accordance with the demand of the Town Council, and to recommend the Town Council to grant an honorarium to MR. J. D. CAIRD, traffic manager, who has been too ill to attend to duty for some time, instead of the annual grant for three years which was previously recommended, and refused by the Council.

MR. R. L. ACLAND, M.I.E.E., has joined the staff of Agricultural and General Engineers, Ltd., of Central House, Kingsway, W.C. 2, in charge of their electrical interests in the North of England, including the Garrett electrical vehicle.

The *Board of Trade Journal* announces that MR. G. T. MILNE, H.M. Trade Commissioner, stationed at headquarters, will be leaving early in February for Trinidad, where he will act temporarily as H.M. Trade Commissioner in the British West Indies during the

absence of Mr. A. J. Pavitt from his post. Mr. Milne will be glad to meet any representatives of firms who may wish to see him regarding any matter affecting their interests in the West Indies at the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1, by appointment.

Obituary.—CAPT. J. ADAMS.—We regret to announce that Capt. J. Adams, of the new cable steamer *Lord Kelvin*, met with a fatal accident at Halifax, Nova Scotia, on New Year's Day. He was formerly in charge of the Anglo-American Co.'s cable steamer *Minia*, and was associated with the latter steamer for over 25 years. He was motoring back to his home when, on passing over a level crossing, an express train smashed into the car, killing both the occupants instantaneously. He leaves a widow and two children.

Wills.—The late MR. THEODORE NEWTON VAIL, president of the American Telegraph and Telephone Co. and other concerns, left property in excess of £1,000,000 in value, of which £46,456 was the gross value of the estate in the United Kingdom. Considerable amounts were bequeathed to universities, technical colleges and institutes in the U.S.A.

MR. FRANKLIN HILTON, M.I.C.E., M.I.M.E., chairman of Browett, Lindley & Co., left £30,398 net, and £33,392 gross, personalty.

NEW COMPANIES REGISTERED.

Santon, Ltd. (172,731).—Private company. Registered January 21st. Capital, £4,000 in £1 shares. To take over the business of electrical engineers carried on by H. C. Sanders, J. F. Fulton, R. C. Taylor and C. W. Buckley at 34, Bridge Street, Newport, as the "Santon Engineering Co." The first directors are: H. C. Sanders, 34, Bridge Street, Newport, Mon.; J. F. Fulton, 40, Bryngwyn Road, Newport, Mon.; R. C. Taylor, 22, Bryngwyn Road, Newport, Mon.; C. W. Buckley, 19, Stockton Road, Newport, Mon. Secretary: R. C. Taylor. Registered office: 34, Bridge Street, Newport, Mon.

Scottish Electric Lamp Repairing Co., Ltd. (11,582).—Private company. Registered in Edinburgh January 17th. Capital, £15,000 in £1 shares. To acquire a licence granted or to be granted by the Allies Electric Lamp Repairing Co., Ltd., London, to use certain patents, machinery and appliances, and to carry on the business of manufacturers, importers, exporters, repairers and fitters of and dealers in electric lamps, &c. The subscribers (each with one share) are: C. Cochran, 55, West Regent Street, Glasgow, solicitor; Jessie Allan, 55, West Regent Street, Glasgow, typist. The first directors are: W. Crawford, Alma, Potterhill Avenue, Paisley; and J. M. Scott-Maxwell, Baillieston House, Baillieston. Registered office: Abercorn Lamp Works, Niddry Street, Paisley.

Ozonair Flour Mill Ventilating Co., Ltd. (172,619).—Private company. Registered January 15th. Capital, £1,200 in £1 shares. To carry on the business of manufacturers of ventilating installations, &c. The subscribers (each with one share) are: H. Audsley, 15, Belmont Terrace, Crackenedge, Dewsbury, clerk; C. Halstead, Ash Villa, Belle Vue Road, Sandal, Wakefield, clerk. The first directors are to be appointed by the subscribers. Ozonair, Ltd., may appoint one director during the continuance of the licence granted to the company. Solicitor: W. H. Kingswell, 36, Wood Street, Wakefield.

Unique, Ltd. (172,640).—Private company. Registered January 17th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in lamp shades, electric and gas globes and fittings, &c. The permanent directors are: D. A. Abrahams, Maitland Cottage, Earlham Grove, Forest Gate, Essex; H. F. Kean, 50, Northumberland Avenue, Wanstead, Essex. Secretary: H. F. Kean. Registered office: 25, Shaftesbury Avenue, W.C.

Rail Welding Co., Ltd. (172,636).—Private company. Registered January 17th. Capital, £30,000 in £1 shares (10,000 10 per cent. cumulative preference). To take over the business of a rail welder carried on by E. Jacob at 119, Victoria Street, Westminster, and at Upper Kennington Lane, S.E., as the "Rail Welding Co." The first directors are: E. Jacob, 11, Chalcot Gardens, N.W.; F. S. A. Lowndes, 9, Barton Street, Westminster; A. P. Strohmenger, Canal Court, Sunningdale, Berks. Registered office: 119, Victoria Street, Westminster, S.W. 1.

Aladdin Lamps (Midlands), Ltd. (172,644).—Private company. Registered January 18th. Capital, £35,000 in £1 shares (25,000 preference). To take over the business of electric lamp manufacturers and agents carried on by the New Process Electric Lamp Co., Ltd., at Sherborne Street, Birmingham, and elsewhere, including the benefit of an agreement with the Aladdin Renew Electric Lamp Corporation, Ltd., of a licence thereby to be granted with the right to purchase a certain electric installation and plant of Tyseley Works, Ladywood, Birmingham, &c. The first directors are: S. Coxon, 20, Calton Avenue, Wavertree, Liverpool; W. A. Williams, Whinmoor, Jubilee Road, Formby; J. T. Jones, 67, Lord Street, Liverpool. Qualification, £100. Registered office: Sherborne Street, Birmingham.

Tully Gas Plants, Ltd. (172,091).—Registered January 19th. Capital, £150,000 in £1 shares (100,000 8 per cent. cumulative participating preference shares and 50,000 ordinary). To acquire the undertaking, assets and liabilities of Bale and Hardy, Ltd., and to carry on the business of contractors, electricians, electrical and gas engineers, founders, smiths, &c. Purchase consideration, £43,650, payable in shares. The first directors are: C. B. Tully, Grey House, Carlton-on-Trent, Newark; P. P. Sandford, 8, Phillimore Gardens, Kensington, W.8; J. W. Tully, 39, Penywern Road, Earl's Court, S.W.; Lt.-Col. H. Thorpe, Coddington Moor, Newark. Minimum cash subscription, seven shares. Qualification (except first directors), £100. Remuneration, £100 each per annum (chairman, £125), free of income tax. Solicitor: G. E. Bruce Millar, Pomeroy House, 28a, Basinghall Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

H. W. Smith & Co. (1920), Ltd.—Mortgage dated December 9th, 1920, to secure all moneys due or to become due from company to Lloyd's Bank, Ltd., not exceeding £50,000 charged on certain freehold premises at Lydbrook Junction, Glos.

Patex, Ltd.—Issue on December 30th, 1920, of £650 debentures part of a series. (Previously issued, £1,100.)

Yorkshire Cable Co., Ltd.—Debenture dated December 29rd, 1920, to secure all moneys which the mortgagees may be called upon to pay under a guarantee to company's bankers, not exceeding £7,000.

East Anglian Electricity, Ltd.—Particulars of £10,000 second mortgage debentures authorised January 4th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Minehead Electric Supply Co., Ltd.—Trust deed dated December 31st, 1920, to secure £12,000 debenture stock charged on leasehold property at Alcombe, Somerset, and company's other assets present and future, including uncalled capital. Trustees: H. D. Leather, East Parade Chambers, Leeds; F. Rishdon, Williton, Somerset.

Park Royal Engineering Works, Ltd.—Satisfaction to the extent of £2,000 on November 23rd, 1920, of second mortgage debenture authorised May 10th, 1915, securing any moneys up to £2,000 which may be paid under a guarantee to the company's bankers.

Marsh Bros. (Electricians), Ltd.—Mortgage dated December 31st, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on the Sheffield Electrical Works.

Ebonestos Insulators, Ltd.—Particulars of £20,000 debentures authorised January 11th, 1921; whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Engineering Equipment Co. (1919), Ltd.—Issue on January 6th, 1921, of £500 debentures, part of a series already registered.

Hudson's Electrical Engineering Co., Ltd.—Particulars of £9,000 debentures authorised December 30th, 1920; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Wigan Electro-Metallurgical Works, Ltd.—Debenture dated December 20th, 1920, to secure £186 10s., charged on company's undertaking and property, including uncalled capital. Holders: British Thermit Co., Ltd., 49-51, The Albany, Old Hall Street, Liverpool. Particulars of £18,000 debentures, authorised by resolution of even date, also filed, whole amount issued, charged on above mentioned property.

Siemens Brothers & Co., Ltd.—Satisfaction to the extent of £23,400 on January 1st, 1921, of debenture stock dated January 15th, 1918, securing £1,330,000.

Westminster Electric Supply Corporation, Ltd.—Satisfaction in full on March 1st, 1920, of debentures dated March 1st and March 29th, 1899, securing £250,000.

Pritchett and Gold and Electrical Power Storage Co., Ltd.—Satisfaction in full on December 31st, 1920, of debentures dated November 14th, 1916, securing £10,000.

Nairobi Electric Power and Lighting Co., Ltd.—Satisfaction to the extent of £1,000 on December 31st, 1920, of debentures dated September 10th, 1913, and July 26th, 1915, securing £20,000.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The annual meeting was held on January 19th at Winchester House, E.C., Mr. J. B. Braithwaite, M.I.E.E., presiding. The chairman said that on the whole they had reason to congratulate themselves upon the result of the working of the company for the past year in view of the exceptional conditions in Adelaide as in other parts of Australia. The year opened with the great seamen's strike, which was settled just at the beginning of their financial year. That was followed by the marine engineers' strike, which caused restrictions to be issued by the authorities which had the effect of reducing their output during the month of February by about 40 per cent. The gross revenue had increased by £46,793, about 25 per cent. That was fairly satisfactory, but the expenses had also increased considerably. Generation costs increased by £22,897; distribution was about £900 up, and repairs and renewals cost them £18,174, as against £13,208, whilst general charges, which included taxes, insurance, &c., showed an increase of £5,800. In round figures while the revenue had increased by about £50,000, expenses had gone up by some £34,500, leaving them with only about £12,760 additional profit. During the year they connected 4,426 additional consumers, raising the number to 29,475, a very satisfactory increase. They had an increase of 4,222 in kW, as compared with an increase of 3,040 kW the previous year; while the sale of units had increased by rather over 3 millions to 14,434,000. He had no doubt that had it not been for the strikes they would have passed the 15 millions mark last year. The miles of streets supplied had increased from 500 to 525, which was about their normal rate of increase. Application was made to the South Australian Government Prices Regulating Commission for permission to increase their rates to meet the increased charges of coal, labour, &c., and they granted them an increase of 15 per cent. The special night tariff which they had adopted was making a little progress. The number of consumers had risen from 95 to 150, which showed that the concession was being appreciated. On the whole, he thought they would agree that the business had stood up against the difficulties it had had to contend with, better perhaps than might have been expected. That was due very largely to the loyalty, zeal, and energy of the local directors in Adelaide, and of the staff. Some progress had been made with the new power house at Osborne, Port Adelaide, although they had not spent much money. Altogether they had spent about £21,000 on that work, and everything went to show that they would soon be able to get to work on erecting the power house, and they had placed orders for a considerable amount of plant which would involve the raising of new capital in order to pay for it. During the year they had spent £133,400 on capital account, and the cost of the undertaking now stood at £1,025,000. As he had said, it would be necessary to raise further capital during the year, but it would be raised in Australia. An offer of ordinary shares was going to be made on February

1st at 25s. per share. They had got 150,000 of those shares available, and they considered that that would give them sufficient money for the current year. He was looking forward to the completion of the Adelaide power house to mark a great epoch in the development of the business, as it would enable them to supply in bulk.

Mr. R. S. Sellon seconded the motion.

Replying to a shareholder, the chairman said that the English shareholders would have the same rights as the Australian shareholders in regard to the new issue of shares if they cared to exercise them.

The report was carried.

Subsequently an extraordinary meeting was held, when the chairman proposed a series of resolutions providing for the transfer of the control of the company to the Adelaide board. He remarked that the course had been forced upon them owing to the action of the Government with regard to the question of income tax. The English Government had insisted upon income tax being paid here on profits earned entirely in Australia. It was quite reasonable that the Australian shareholders, who formed the majority of the shareholders, should object to paying their own tax in Australia and British income tax as well. The board had done their best to try and bring home to the Government the injustice of such a procedure, but beyond getting a small concession last year, they had not been able to get the injustice altered. Resolutions for removing the control of the company to Australia had already been passed by the Colonial shareholders. Fortunately they had a most excellent board in Adelaide on whom they could thoroughly rely to look after their interests. If the resolutions were carried they would effect an immediate economy of about £12,000 a year for the benefit of the shareholders.

Mr. A. F. Farish seconded the resolutions, which were opposed strongly by two holders of "A" preference shares on the ground that removing the control of the company from London would depreciate their holdings; but eventually the resolutions were carried.

Costa Rica Electric Light and Traction Co., Ltd.

For the year ended June, 1920, the net earnings in Costa Rica were £24,519, against £14,328 for the previous year. The net profit for the year was £12,691, against a loss of £2,549 for the previous year. The deficit of £13,022 is reduced to £330. The gold premium has averaged 160 per cent. during the year, as against 315 per cent. in the previous year, and 112 per cent. (the normal equivalent of the gold "colon") in the year (1913-14) before the war. At the last-mentioned rate the net profit in Costa Rica for the year under review, which amounts to C318,670.43, an increase of C21,365.08 on that of year ending June, 1919, would have been £30,063, as against £24,519, the difference between the current and normal exchange representing a loss of £5,544. The hope expressed by the directors in last year's report that they might resume payment in cash of the 5 per cent. debenture interest on June 30th, 1920, was realised, and the interest due on January 1st, 1921, was also paid in full. The directors had hoped to be able to pay off the first of the deferred warrants (that dated January, 1918), but they are informed by the trustees that the latter cannot consent to this payment at the present juncture.

British Columbia Electric Railway Co., Ltd.

The directors' report for the year ended June 30th, 1920, shows that after deducting £164,745 for depreciations, sinking fund, and renewals, and £13,000 for corporation profits tax, the net revenue from all sources was £412,327, plus £6,258 brought forward, making £418,585. Debenture interest absorbs £132,339, dividend on the 5 per cent. cumulative perpetual preference stock for the year £72,000, interim dividend at 3½ per cent. on the preferred ordinary stock for the year £65,032, and interim dividend at 3½ per cent. on the deferred ordinary stock £65,032, leaving available for further distribution £84,181. From this the directors recommend a final dividend on the preferred ordinary stock at the rate of 23s. per cent. per annum, free of tax, making £4 13s. per cent., free of tax, for the year, £21,368, and a final dividend on the deferred ordinary stock at the rate of 54s. per cent. per annum, free of tax, making £6 4s. per cent., free of tax, for the year, £50,167, leaving £12,646 to be carried forward. Taxation continued to increase rapidly. The following statement shows the amounts paid for the year 1920, as compared with the previous years of 1919 and 1918:—

	1918	1919	1920
	$	$	$
Dominion Government Income Tax	21,100	97,477	101,000
Provincial Government Revenue and Property and Land Tax	54,716	60,550	67,831
Municipal Taxation	96,990	130,554	204,267
	$172,806	$288,581	$373,098

In last year's report it was stated that a Public Utilities Commission had been established in British Columbia entrusted with the duty of regulating the rates charged by the company for its various services to the public, but that owing to an amendment of the General Railway Act of the Dominion of Canada, passed on July 7th, 1919, the railways of the company had passed from the jurisdiction of the Province of British Columbia and of the Public Utilities Commission, referred to above, to that of the Dominion of Canada and of the Dominion Railway Board. It was also explained in last year's report that it was anticipated that legislation by the Dominion Parliament, reversing the amendment of 1919, would be passed early in 1920, the effect of which would be to return the company's railways to the jurisdiction of the Public Utilities Commission of British Columbia. As anticipated, legislation of this character was passed by the Dominion Parliament on July 1st, 1920, and the result, as indicated, would have been again to place questions relating to the company's railway in the hands of the Public Utilities Commission of British Columbia, but for the fact that somewhat earlier—in April, 1920—the Parliament of British Columbia had repealed the Public Utilities Act of British Columbia, thus abolishing the Public Utilities Commission, giving as their reason for so doing that, as the affairs of the railway had passed under the jurisdiction of the Dominion Railway Board, a Public Utilities Commission in British Columbia was no longer required. As the consequence of these events would have been to leave the company without any authority to whom appeal could be made for the regulation of rates and fares, a provision was incorporated in the Dominion Act of July 1st, 1920, providing for the retention of the company's railways under the Dominion Railway Commission for one year from the passing of the Act, viz., until July 1st, 1921. The question as to what authority will regulate rates and fares after July 1st, 1921, is undecided and is engaging the attention of the directors, who are hopeful that some satisfactory arrangement may be arrived at.

The net earnings of the company for the first five months of the current year, compared with those of the year under review, are as follows:—

	1919.	1920.	Increase.
	$	$	$
July	149,109	174,685	25,576
August	166,808	187,984	21,176
September	181,811	183,327	1,516
October	183,415	184,339	924
November	214,119	214,789	670
	$895,262	$945,124	$49,862

Expenditure on capital account from July 1st, 1919, to June 30th, 1920:—

	$
Light and power extensions	212,088
Transmission lines and other electrical equipment ...	55,782
Railway extensions and developments	103,273
Lands and buildings	50,879
Trucks and sundry equipment	99,072
	$521,094

In presenting the above report at the general meeting, held on January 20th, Mr. G. P. Norton (chairman) said it was a report showing clearly a considerable improvement during the past year. This was due to an increase of revenue consequent upon the expanding trade and increased population of British Columbia. The speaker trusted that it was no longer necessary to tell the local authorities and public of British Columbia that, as the development of the Province depended to a great extent upon the development of its utilities, it was essential that the return secured should be sufficiently attractive to investors. A substantial capital expenditure had been necessitated by the expansion of the population, but the sound financial policy of the company in the past had enabled this to be made without calls for fresh capital. The company was financed on perpetual debentures; had these been redeemable much of the provision made for depreciation would have been absorbed by the redemption fund, and fresh capital would have been required.

Since 1912 the greater part of the output of the Western Power Co. of Canada had been taken by the company, and it had been thought desirable to obtain a controlling interest in the Power Co. Arrangements have now been made whereby the majority of the share capital of the Power Co. has been acquired on terms involving a comparatively small capital expenditure. It is intended to draw up plans for a fuller use of the Western Power Co.'s undertaking.

He (the speaker) was often asked the reason for the low prices of the company's securities and stocks; he invariably replied that it was due to Stock Exchange conditions and to a lack of complete confidence on the part of investors that a fair arrangement for the control of rates would be arrived at. There was no reason why the company, which had done so much to create prosperity in the province, should not share in that prosperity.

Mr. J. Davidson, who had recently paid a visit to Canada, gave his impressions and statistics of traffic. He stated that the number of passengers carried increased from 53,326,288 to 66,411,030, and freight carried from 331,794 tons to 430,931 tons. In addition to this, the electricity sold (in kW-hours) increased from 94,953,424 to 116,196,981.

The balance sheet and reports were adopted, and the directors and auditors re-elected.

French Companies.

The meeting of December 2nd of the *Société d'Electricité de Paris* has voted the distribution of 20 fr. per share and 33.33 fr. per part *bénéficiaire*. The credit balance of the profit and loss account has risen to 2,543,096 fr. The sales of energy totalled 185,589,189 kWh, against 134,357,660 kWh in the foregoing year.

The receipts for the financial year 1919-20 of the *Est-Lumière Co.* showed a loss on working of 4,860,156 fr., making with the deficit of last year a total of 9,578,026 fr. To secure the means of which the society stands in need, it is proposed to increase the capital and make an issue of bonds.

An amalgamation has been arranged between the *Société Westinghouse* and the *Compagnie Electro-Méchanique*, the shareholders of the former company giving eight of their shares for one of the latter.

The shareholders of the *Etablissements Paz et Silva* passed the accounts on December 10th, showing a profit of 612,482 fr., and fixing a dividend of 11 fr. per share. The report is hopeful of the early abolition of trade restrictions imposed during the period of the war, and has worked to enlarge its branches, and to turn out from its works articles previously imported from England and America. The increase of its capital will enable it to purchase raw materials and enlarge its works.

Stock Exchange Notices.—The following have been ordered to be officially quoted :—

General Electric Co., Ltd.—78,641 ordinary shares of £1 each, fully paid (Nos. 2,033,335 to 2,111,975); and 22,891 7½ per cent. "B" cumulative preference shares of £1 each, fully paid (Nos. 1,600,001 to 1,622,891).

Hurst, Nelson & Co., Ltd.—200,000 ordinary shares of £1 each, fully paid (Nos. 1 to 200,000).

Lancashire Power Construction Co., Ltd.—400,000 6 per cent. (income tax free up to 6s. in the £) cumulative convertible first preference shares of £1 each, fully paid (Nos. 1 to 400,000).

London Electric Wire Co. & Smiths, Ltd.—400,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 400,000).

Mississippi River Power Co.—$648,300 first mortgage 5 per cent. 40-year gold bonds (Nos. C3,766 to 3,958 of $100, D13,002 to 13,067 of $500, and M16,321 to 16,916 of $1,000).

Petters, Ltd.—112,500 ordinary shares of £1 each, fully paid (Nos. 1 to 112,500) and 200,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 200,000).

A Swiss Investment Company.—The directors of the A.G. Columbus fur Elektrische Unternehmungen, of Glarus, reporting on the year 1919-20, state that the company's subsidiary—the Compania Italo-Argentino de Electricidad, of Buenos Aires—experienced a rapid increase in revenue in the past financial year, paid a dividend of 7 per cent., as against 6 per cent. in 1918-19, and raised its share capital to 1,000,000 dollars. The Swiss company, which participated in the augmentation by the conversion of a part of its loans to the Argentine company into new shares, proposes to pay a dividend of 7 per cent. out of net profits of 2,740,000 fr., being the same rate as in 1918-19, when the net profits amounted to 2,250,000 fr.

Shanghai Electric Construction Co., Ltd.—With a view to bringing the capitalisation of the company more nearly into accord with the value of its undertaking, the directors have decided to recommend an increase of capital from £320,000 to £400,000, and the capitalisation of £80,000 of undivided profit, by issuing as a bonus 8,000 fully-paid shares of £10 each (giving one new share for every four shares now held). The new shares will not rank for dividends payable out of the profits for the year 1920. The directors have declared a second interim dividend of 6 per cent. (12s. per share), less income tax (payable on February 1st), in respect of the year 1920.

Chatham & District Light Railways Co.—The report for 1920 shows that the revenue was £90,716, and the expenses were £69,174. After deducting from the balance, rent of Rochester Corporation lines, £3,744, interest £2,403, and £6,000 depreciation reserve, the balance is £9,395, plus £3,393 brought forward. Dividends of 5 per cent. on the preference and ordinary shares are paid, and £1,609 is carried forward. There was an increase of £11,876 in revenue and £16,559 in expenses, as compared with 1919. £842 was expended on deferred repairs. The investments have been written down to market value as at December 31st, 1920.

East London Railway Co.—The report for 1920 shows total gross receipts (estimated) £101,343; 56 per cent. of £101,343 would give the company £56,752 instead of the minimum rental of £30,000 per annum. Warrants have been posted for the six months' interest on £2½ per cent. (Whitechapel Extension), first (3½ per cent.), and second charge £4 per cent., Class "A" debenture stocks, also for 10s. per cent. for one year on the second charge £4 per cent. debenture stock Class "B."

Yorkshire (West Riding) Electric Tramways, Ltd.—The report for the year ended December 31st, 1920, shows, after providing for debenture interest, a net income of £28,676. Adding the amount brought forward, the available balance is £30,062. Dividend at 6 per cent. per annum, less tax, on 6 per cent. cumulative preference; to renewals, depreciation, and reserve fund, in lieu of accident insurance, £20,347.—*Financier.*

Companies Struck off the Register.—The undermentioned companies have been struck off the register and are dissolved :—

British Prometheus Co., Ltd.
Deaphone Co., Ltd.
Hemming Conduit Grip, Ltd.
Llanelly Motor & Electrical Engineering Co., Ltd.

British Mannesmann Tube Co., Ltd.—A large majority of the shareholders of the company having accepted the offer of Baldwins to effect an exchange of shares, the directors of both companies have decided to complete the provisional agreement establishing a fusion of interests.

Montreal Light, Heat and Power Companies.—The *Financial Times* states that the following dividends have been declared : 5 per cent. on Montreal Light, Heat & Power Consolidated shares, and 8 per cent. on Montreal Light, Heat and Power Co. common shares for the quarter ending January 31st.

Kaministiquia Power Co.—Dividend on the common stock for the quarter ending January 31st at the rate of 8 per cent. per annum.

Elliotts' Metal Co., Ltd.—Interim dividends, less tax, of 5 per cent. per annum on preference shares and 1s. per share on ordinary shares.

Metropolitan Railway Co.—The directors recommend, subject to final audit, a dividend on the ordinary stock for the past half-year at the rate of 2 per cent. per annum, making 1½ per cent. for the year, carrying forward about £15,500, after placing £50,000 to general renewals fund.

Gwynnes, Ltd.—Dividend for the eight months to September 30th, 1920, at the rate of 5 per cent. on the preference and 10 per cent. on the ordinary shares, £46,980 to carry forward.

Vera Cruz Electric Light, Power & Traction Co.—Dividend, 5 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

LAST week there was a good deal of buoyancy about the markets, more particularly those for gilt-edged stocks. This week, the wheel has turned in the other direction. In the House it is said that clients are beginning to get uneasy at the prospect of the Trades Unions and the Labour Party declining to fall in with the Government's scheme for dilution, whereby unemployment could be reduced, and work could be spread over a wider area. Possibly a simpler explanation is to be found in the fact that the remarkable jump in the price of the War Stock brought in a good many sellers. Moreover, the discounting of a fall in the Bank Rate was overdone, and at the beginning of the present week there was some little hint that, after all, money might not get cheaper for some time longer than the prophets had anticipated who put the end of this month as the latest date at which the 7 per cent. Bank Rate would be retained.

Nevertheless, investment stocks are holding their prices very well on the whole. The closing of the lists for the new W. T. Henley shares, before the advertised date for doing so, shows that there is plenty of money available for subscription to tempting offers even in the industrial world. We understand that the Melbourne Electric Supply Co. contemplates an issue of 8 per cent. preference shares of £5 each, and that the issue price will be arranged at about 95s. Quite a number of new issues which were made towards the end of last year, and which were left substantially in the hands of underwriters, are being absorbed, and prices naturally tend to improve.

Gas Light & Coke stock fell heavily, on the announcement that the price of gas was to be put up, but this has not affected any of the shares in the electric lighting list. It ought, of course, to have a strengthening effect, in that the electric undertakings are not bound by any sliding scale arrangements whereby dividends must be reduced if the price of the illuminant goes up, and vice versa. If the electric lighting companies increase their charges, this might have a favourable effect upon dividends. There are buyers about of City of London preference at 16s. 3d., and Newcastle-on-Tyne 5 per cent. preference are wanted at 12s. 6d., the company's 7 per cent. preference being also in demand at 18s. 3d. Bournemouth and Poole 4½ per cent. first preference can be sold at 5½, and the company's 6 per cent. second preference at a pound per share higher; the 4½ per cent. debenture stock can be placed at 56, and British Electric Traction 5 per cent. debenture stock is inquired for at 59. Debenture stocks of the various electricity companies are in short supply. It may be useful to holders if we set out a short list of those more particularly wanted, with the prices which can be obtained. The latter can probably be improved upon, especially in those cases where there is little stock in the market. The following list is confined to debentures and debenture stock only :—

Company.	Interest.	Price.
Anglo-Argentine Trams	4 p.c.	57
ditto	5 p.c.	56½
Auckland Tram	5 p.c.	87
Charing Cross, West End & City ...	4 p.c. & 4½ p.c.	67
Chelsea	4½ p.c.	75½
County of London	4½ p.c.	66
English Electric Sinking Fund 1st Mort.	5½ p.c.	82
London Electric Supply 1st Mort. ...	4 p.c.	70
Metropolitan Electric 1st Mort. ...	4½ p.c.	54
North Met. Elec. Power Supply ...	5 p.c.	55
South Met. Elec. Light 1st Mort. ...	4½ p.c.	69½
Toronto Power	4½ p.c.	63

The Metropolitan Railway's increased dividend of 2 per cent., making 1½ per cent. for the year, against 1¼ per cent. for the previous twelve months, had a strengthening effect upon the Underground list. Districts have risen to 16½. Metropolitans themselves are better at 22. London Electric ordinary rose to 2½. Underground Electric £10 shares at 2 are ¼ higher, and the Income Bonds at 66½ show a gain of 3 points. Electric railway stocks, unlike those of the steam stocks, offer a fair amount of resistance to the general heaviness which, in the early part of the week, made itself felt in the Stock Exchange.

Metropolitan Electric shares are ¼ better at 2½, and Westminsters at 5½ have added a similar fraction. Manufacturing

shares are quiet, with Cromptons a weak market at 13s. 9d. The company's 6 per cent. preference shares are lower at 16s. 9d. British Electric Transformer preference hardened to 16s. 3d. Metropolitan-Vickers preference at 1 13/16 have lost the greater part of the rise gained last week, and the ordinary shares are easier at 18s. 9d. Babcock & Wilcox eased off to 2¼, and Edisons are offered at 12s. 6d.—possibly a little cheaper. Yorkshire (West Riding) Electric Tramways reports a net revenue for last year of £28,700, being a decrease of nearly £14,000 as compared with 1919. The preference dividend is to be paid, but nothing is carried forward.

In the telegraph market the debenture stocks are in demand. Eastern Telegraph 4 per cent. debenture stock at 63½ and Eastern Extension 4 per cent. debenture at a point lower are both better on the week. The ordinary stocks have also improved. Globes have risen to 15¼, Westerns and Chinas to the same price, while Eastern ordinary remains at 154½. Anglo-American Telegraph preferred and deferred are both better, the latter adding ½ and the preferred gaining 3 points at 78½. Great Northerns at 21½ are a point up, but on the other hand, West India and Panama shares are flat at 11s. 3d. United River Plate Telephones at 6½ are 5s. to the good. Marconis have weakened to 2 1/16, the preference to £2 and Marines to 25s., while the Radio shares remain almost unchanged at 11s. 3d. and 8s. 3d. for preferred and common respectively.

Victoria Falls ordinary at 9s. are a little better. Mexico Trams at 40½ are 2½ higher, and the Sixes at 27½ gained a point. No change has occurred in the British Columbia Electric group. Rubber shares are dull and heavy, owing to the price of the raw stuff having gone back to nearly 1s. per lb., and in the armament market, movements are mostly downwards in consequence of the uncertainties provoked by the labour outlook.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 25, 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	8¼	—	10 0 0
do. do. do. 4½ Pref.	4½	4½	2⅞	—	8 8 8
Chelsea	3	4	8¼	—	6 8 0
City of London	8	10	1⅛	—	8 12 9
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7⅛	—	10 18 4
do. do. 6 per cent. Pref.	6	6	7⅞	—	7 15 0
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	¾	—	10 0 0
do. do. 6 per cent. Pref.	6	6	2⅞	—	10 18 2
Metropolitan	5	6	2¾	+ ⅛	10 8 8
do. 4½ per cent. Pref.	4½	4½	2⅛	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	2¾	—	9 12 0
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	8½	+ ⅛	9 17 6
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	78¾	+3	12 10 0
do. Def.	33/6	4½	18⅞	+ ⅛	9 13 6
Chile Telephone	8	6	5⅝xd	—	*8 4 4
Cuba Sub. Ord.	7	7	6⅜	— ⅛	*10 15 4
Eastern Extension	8	10	15½	+ ⅜	*8 9 0
Eastern Tel. Ord.	8	10	154¼xd	—	*8 9 5
Globe Tel. and T. Ord.	8	10	15½	+ ⅛	*6 9 0
do. do. Pref.	6	6	8⅞	+ ⅛	6 17 2
Great Northern Tel.	22	22	21⅝	+1	10 4 8
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2 1/16	— 1/16	—
Oriental Telephone Ord.	10	12	2⅞	—	*5 4 0
United R. Plate Tel.	8	8	6⅝	+ ⅛	*6 10 8
West India and Panama	1/8	Nil	1/16	— 1/16	Nil
Western Telegraph	8	10	15½	+ ⅛	*8 9 0
HOME RAILS.					
Central London Ord. Assented	4	4	43½	—	9 4 0
Metropolitan	1	1½	52	+1½	6 16 4
do. District	Nil	Nil	16½	+1	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/6	+6d.	Nil
do. do. Income	5	4	66½	+3	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	2⅜ xd	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	9⅛	—	Nil
do. do. 5 % Deb.	5	5	67½	+1	8 18 10
Brazil Tractions	Nil	Nil	3⅛	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55xd	—	9 1 10
do. do. Preferred	2½	5	54½	—	*8 9 9
do. do. Deferred	Nil	3	53½	—	*11 8 4
do. do. Deb.	4½	4½	64½	—	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	+2½	Nil
do. 6 per cent. Bonds	Nil	Nil	27½	+1	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	−1	Nil
do. 1st Bonds	Nil	Nil	64½	−1	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2¼	— 1/16	*6 13 4
British Aluminium Ord.	10	10	4⅜	—	11 8 6
British Insulated Ord.	12½	15	1⅜	—	9 5 10
Callenders	25	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅛	—	7 12 9
Crompton Ord.	10	10	13/9	−2/-	14 11 0
Edison-Swan	10	10	12/6	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	⅜	—	11 8 6
Gen. Elec. Pref.	6½	6½	18/-	—	7 4 5
do. Ord.	10	10	1⅞	—	*8 4 8
Henley	25	15	1¼	—	10 8 0
do. 4½ Pref.	4½	4½	3½	+ ⅛	6 18 6
India-Rubber	10	10	⅜	—	—
Met.-Vickers Pref.	—	8	1 13/16	+ 1/16	8 16 4
Siemens Ord.	10	10	1⅞	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/4	1d. dec.
a Ammoniac Sal	per ton	£110	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£38	...
a Copper Sulphate	,,	£38	£3 dec.
a Potash, Chlorate	per lb.	8d.	...
a ,, Perchlorate	,,	1/0	2d. dec.
a Shellac	per cwt.	£20	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£33	...
a ,, Lump	,,	£18	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£7	£1 dec.
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£96 to £800	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1½	½d. inc.
c ,, Tubes (solid drawn)	,,	1/3½ to 1/8	½d. dec.
c ,, Wire, basis	,,	1/0	½d. dec.
c Copper Tubes (solid drawn)	,,	1/5	½d. dec.
c ,, Bars (best selected)	per ton	£124	£5 dec.
c ,, Sheet	,,	£124	£5 dec.
c ,, Rod	,,	£124	£5 dec.
d ,, (Electrolytic) Bars	,,	£90	70/- dec.
d ,, ,, Sheets	,,	£148	...
d ,, ,, Wire Rods	,,	£96	70/- dec.
d ,, ,, H.C. Wire	per lb.	1/-	½d. dec.
d ,, ,,	,,	1/½	½d. dec.
f Ebonite Rod	,,	8/6	...
f ,, Sheet	,,	8/-	...
n German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	14/- to 16/-	...
h India-rubber, Para fine	,,	1/0½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£50	£4 dec.
g Lead, English Pig	,,	£35	£1 dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	,,	1/6 to 1/11	...
p ,, ,, rolled bars and rods	,,	2/5 to 2/8	...
p ,, ,, rolled strip & sheet	,,	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	1/8	...
r Steel, Magnet, in bars	,,	1/8	2d. dec.
n Tin, Block (English)	per ton	£164 to £165	£17 to £18 dec.
n ,, Wire, Nos. 1 to 16	per lb.	4/8	3d. inc.
p White Anti-friction Metals	per ton	£78 to £900	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
p ——
r W. F. Dennis & Co.

A Novel Electrical Precipitator.—*Chemical and Metallurgical Engineering* recently described, under the above heading, an installation to deal with the smoke of a battery of 32 McDougall roasters at a smelting works. With a remarkably low power input, this plant gives recovery of values exceeding 90 per cent. The smoke is discharged into a "dust chamber," which is connected by a short length of flue to the main smelter chimney. In the flue are corrugated iron sheets, suspended from the roof and set parallel to the flue walls to act as collecting electrodes. Discharge electrodes between the plates are formed of gridirons, of small iron pipe placed horizontally and hung from supporting beams at the ends and middle point. Dusty gas thus passes through an electrified atmosphere from the dust chamber to the stack. In this precipitator there is a very definite selective action on the mixed smoke. The first hoppers collect material high in copper, while toward the far end the dust is sufficiently high in lead content for its yieldings to be sent to the lead blast-furnace plant. The electrical capacity of the apparatus is 50 kVA, and it is able to deal with eight or nine tons of dust daily.

Engineers' Clubs.—We are informed by the hon. secretary of the Provisional Committee of the Engineers' Club (Birmingham), Mr. J. Fearn, A.M.I.M.E. (c/o B.S.A. Co., Ltd.), that Sir Alfred Herbert, K.B.E., Mr. Lincoln Chandler (of the Metropolitan Carriage Works), and Mr. Donald Hope (chairman of Messrs. Henry Hope & Sons, Ltd.) have accepted vice-presidencies of the club. Applications for membership are coming in rapidly, and those who wish to have the use of the club directly it is opened should apply soon, or they will find themselves on the waiting list. We have received from Mr. Fearn a list of members, in which we notice many well-known names. The president is Sir Hallewell Rogers, J.P., M.P.

The proposed Engineers' Club for London was mentioned at the informal meeting of the I.E.E., on Monday last, by Mr. G. Layton, who urged that the Council should afford encouragement and support to the scheme. About 50 gentlemen have already agreed to act on the Provisional Committee, including many of the most eminent members of the various branches of engineering.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Concluded from page 73*).

Mr. H. W. SULLIVAN exhibited a selection of interesting apparatus and instruments, including Cox's selenium amplifier for use in connection with submarine telegraphy, which was shown in operation; its novelty should make the apparatus of general interest, although two modified sets have been in operation at one of the Pacific Cable Board's stations for some years. The instrument is used to increase the working speeds of submarine cables by amplifying the very attenuated

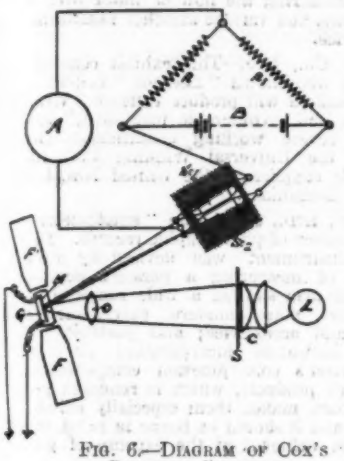

FIG. 6.—DIAGRAM OF COX'S SELENIUM AMPLIFIER.

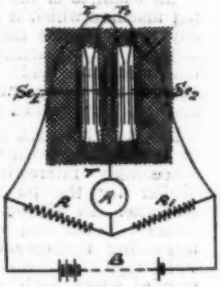

FIG. 7.—DIAGRAM OF SELENIUM CELL.

signals received at high speed sufficiently to operate ordinary recording or relaying apparatus. It is illustrated in fig. 6. A beam of light from the source L is projected on the mirror of the receiving galvanometer G, and thence to a pair of selenium cells se_1, se_2, which are arranged as a pair of bridge arms. With the galvanometer at zero, the surface of each cell is half light and half dark and the bridge system is balanced. Deflections of the galvanometer by received signals cause corresponding variations in the position of the light area on the cells and large corresponding changes in the relative resistance of the cells, thus actuating the instrument A, which may be a recorder of any desired type. In practice a large number of very narrow cells or sections of a cell is used, these being arranged in pairs with one "bar" of light to each pair, so as to make full use of the very small galvanometer deflections obtained when working at high speed on long cables; the various pairs are connected as a series of bridges in parallel, two such pairs being illustrated in fig. 7. Fig. 8 shows a working cell of 24 pairs of sections, the total selenium surface being 4 by 4 in. The terminal bar T is common to all sections, and the bars T_1 and T_2 are connected respectively to the right and left-hand sections of each pair. In the latest pattern all three terminal bars are cut in half so that a group of selenium sections may be placed in all four bridge arms, a small adjusting slide resistance at one apex of the bridge is then the only idle resistance in the circuit. The success of the system is due to the improved "plate" or built-up type of cell used. It has proved, during more than six years' continuous working, to be reliable, and it does not appear to deteriorate if correctly made. Its working resistance in the amplifier is about 1,000 ohms for each of the four groups of sections, or 4,000 ohms per sq. in. of surface. The inertia is comparatively small, and its effect is eliminated from the instrument A by shunting A with an inductance. Cells of this type can be made in smaller sizes for other purposes and sub-divided or not as required; they will respond satisfactorily to telephonic frequencies. Amplification is generally adjusted by varying the voltage of the battery B; with B=100 volts, L=100 c.p., and the cell placed about 15 in. from the galvanometer mirror, the energy applied to the galvanometer may be amplified ten thousand times in the instrument A. An amplification of forty thousand may be obtained by making L=500 c.p., B=150 volts, and in some cases sub-dividing the cell further. In ordinary practice in submarine telegraphy an amplification of 1,000 to 5,000 is usually sufficient to work a good Morse relay. The high amplification has enabled a simple and accurate method of correcting for earth currents and other causes of zero variation to be applied. An auxiliary relay in the selenium-bridge circuit controls a motor-driven rheostat which adjusts the balance of this bridge circuit so as to compensate for any zero variation in the system whether due to earth currents or other causes.

The novel single-valve amplifying receiver for extra wide wave-length range (600 to 20,000 metres) was shown for the first time at the exhibition. The set is self-contained, the aerial and earth leads being brought direct to it; the only apparatus required external to the set are the 4-volt accumulators, 50-volt anode dry battery, and a pair of high resistance telephones. Single-circuit tuning is employed, the inductance being a continuously variable multi-coil variometer, fig. 9, in which an exceedingly high range of mutual inductance variation is obtained. The coils of the variometer are very flat and are embeded in insulating disks, one of which D_1, may be rotated between the other two D_2 and D_3. This arrangement gives an evenness of scale throughout the whole 180 deg. of movement. An inductance range of from 3,500 to 50,000 microhenries is obtained on the long wave-length scale, whilst a two-position multi-functioning switch S alters the internal variometer connections to obtain a short wave-length inductance range of from 200 to 3,500 microhenries. An inductance ratio of 250 to 1 is thus obtained throughout the range of the

FIG. 8.—SELENIUM CELL.

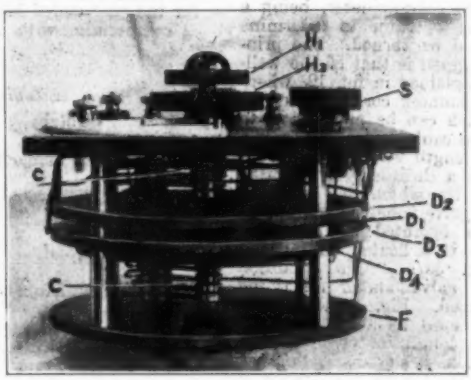

FIG. 9.—VARIABLE MULTI-COIL VARIOMETER.

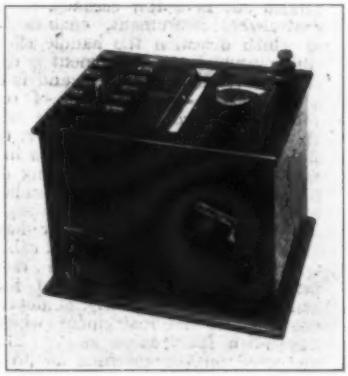

FIG. 10.—YARDOMETER.

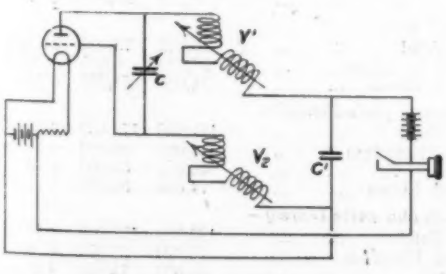

FIG. 11.—HETERODYNE WAVEMETER DIAGRAM.

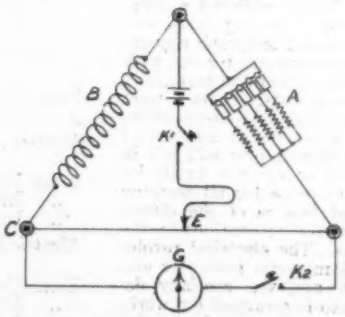

FIG. 12.—YARDOMETER CONNECTIONS.

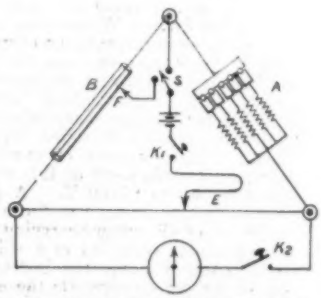

FIG. 13.—YARDOMETER FAULT LOCATOR.

instrument. The variometer is used in conjunction with an adjustable bank of fixed condensers which may be placed either in series or in parallel with the variometer by means of a series-parallel switch giving the wave-length range stated above. The variometer is also fitted with a set of reaction windings which are embedded in the disk D_4, and rotated relatively to the main inductance on a spindle concentric with the spindle of the latter, the two operating handles H_1 and H_2 being conveniently placed one above the other. The mutual inductance between the variometer coils and the reaction coils (the latter being also changed by the long-short wave switch S) may be adjusted to such values as will produce self-oscillation of any frequency corresponding to wave-lengths between 600 and 20,000 metres. The whole of the moving system is supported in upper and lower bearings carried by a framework F of rigid construction, which also supports the fixed system. Connection is made to all moving units through contact rings and fingers C.

A continuous-wave wavemeter with a range of from 600 to 6,000 metres, which can be used also as a plain oscillation generator for use in the separate heterodyne method of c.w. reception, was also exhibited for the first time. The circuit used is shown in fig. 10, the oscillatory circuit consisting of the variable air condenser C and the two variometers V_1, V_2, the circuit being closed to high-frequency oscillations by the fixed capacity C_1 of a sufficiently large value not to appreciably affect its natural frequency.

A new instrument called the "Yardometer," embodying a number of novel features, has just been designed by Messrs. Callender's Cable & Construction Co., Ltd., and Mr. W. E. Benson, for directly indicating the length of cable on a drum or coil without unwinding and passing it through a lineal measuring machine; the instrument has been specially designed to enable a person without any skill or technical knowledge to measure unknown lengths of cable by a simple mechanical operation. The instrument can also be used as a fault locator, and the approximate position of a fault in a drum of cable, or in a coil, can be located by a simple calculation. The instrument (fig. 11) comprises a handle for rotating a cylinder, on which the scale is marked in yards, a number of balancing resistances corresponding to 110 yards at 60 deg. F. of all the C.M.A. sizes from 1/.036 to 19/.064, and an indicating galvanometer and a key. In order to test a length of cable, say, 7/.044, the balancing coil marked with this gauge is plugged in, the handle rotated, and the key momentarily depressed until the galvanometer pointer is stationary, when the correct length in yards is read off on the scale through the window in the front. The whole operation can be carried out in a few seconds, as the galvanometer, being a central-zero instrument, enables the operator to determine in which direction the handle should be turned. The principle on which the instrument is designed is that of the well-known Wheatstone bridge, and is explained in fig. 12, where A is any one of a number of resistances corresponding to various standard sizes of cable which can be plugged in to balance the cable under test; B is the cable under test, C_1 D a slide wire of 1,000 actual inches in length wound on a drum with a contact maker E working on a threaded rod operated through gearing from the handle by which the drum is rotated; G is a sensitive indicating galvanometer, and K_1, K_2 are battery and galvanometer keys operated by the same knob. The correct length of cable is indicated on the dial when the ratio of B/A=the ratio CE/DE, this condition being shown by the needle of the galvanometer remaining stationary when the key is depressed. Fig. 13 shows the operation of the instrument when used as a fault locator. Suppose a fault exists at F. The length of cable is first measured on the machine as previously explained, then by means of a 2-way switch S, the contact with the switch is changed from L to F; the handle is then rotated until the needle is at rest, when the actual distance from D in yards $=x(L+110)/(x+110)$, where x=observed distance and L=length of the cable in yards. For example, suppose the faulty cable is 220 yards long and that with the switch on F the balance is obtained at 80 yards, then the actual distance of the fault=80(220+110)/(80+110)=139 yards. The instrument will be found particularly useful for locating faults in cables lying in water in the test tanks, and which have no metallic sheath. The incorporation of the simple 2-way switch in the instrument, where the terminal is connected to the water tank, is original, and effects a great saving of labour.

MESSRS. ELLIOTT BROS. (LONDON), LTD., exhibited a large selection of apparatus and instruments, including small d.c. motors for driving Wheatstone and Baudot telegraph apparatus; portable multiple-range current transformers for use with dynamometer ammeters and wattmeters, which had practically straight-line ratios and negligible phase angle. They were fitted with self-contained non-detachable short-circuiting switches for the secondary windings whereby the instrument under test can be detached and the transformer still left in circuit without danger of overheating or damage to its insulation; transformers of this type are made for all working pressures up to 20,000 V. A special feature of the direct-reading potentiometer was the high insulation obtained by the enclosure of all current-carrying parts. The electrical revolution indicator consisted of a shielded magneto generator and liquid damped indicating instrument, and was specially designed for use on aircraft; the magneto is arranged for working one or more instruments. The portable speed recorder comprised a recording voltmeter and magneto generator, specially adapted for recording either more or less uniform speeds, or for obtaining acceleration curves where the speed varies at a very rapid rate. Other instruments shown included G.P.O. detectors, galvanometers, and the latest patterns of E.B.L. and "Century" testing sets, &c.

THE DUBILIER CONDENSER CO., LTD., exhibited a number of condensers, including suitable types for use in connection with wireless telegraphy, power factor correction, and the protection of h.p. lines from the effect of lightning and surges.

THE LEA RECORDER CO., LTD., had on view the instrument portion only of its well-known indicating, recording, and integrating machine for measuring the flow of water over V notches, or rectangular weirs, and various sketches illustrating the application of the device.

THE IGRANIC ELECTRICAL CO., LTD.—This exhibit consisted of an example of the now well-known "Leesona" coil-winding machine which it is claimed will produce coils of "virtually indestructible solidity and invulnerable insulation," and capable of withstanding severe working conditions. The machines are made by the Universal Winding Co., the Igranic Co. being the sole supplier in the United Kingdom and British Colonies and Dominions.

MESSRS. GAMBRELL BROS., LTD., showed an "emotometer" in use, together with a number of photographic records. This exceedingly interesting instrument was devised by Prof. Waller for the purpose of measuring a person's nervous response. In addition the firm showed a wide range of resistance boxes and bridges, potentiometers, galvanometers, measuring instruments, and accessories; also portable and wall type temperature indicators incorporating platinum couples fitted with Onwood's cold junction compensators. The cheapness of the firm's products, which is rendered possible by quantity production, makes them especially suitable for educational purposes; and it should be borne in mind that reduction in cost is not achieved at the expense of good accuracy.

THE IMPORT TRADE OF INDIA.

THE following statistics of the imports of electrical and similar goods into British India in the year ended March 31st, 1919, are taken from the recently-issued official trade returns, details for the year ended March 31st, 1918, being added for purposes of comparison, with notes of any increases and decreases.

		1917-18	1918-19	Inc. or dec.
		£	£	£
Copper wire, excluding telegraph and telephone wire :—				
Total ...	cwt.	8,267	11,238	+ 2,971
	£	77,000	88,000	+11,000
From United Kingdom	cwt.	444	502	+ 58
	£	4,000	4,000	—
,, Japan	cwt.	7,700	8,200	+ 500
	£	72,000	68,000	− 4,000
Iron wire—				
Total ...	tons	7,600	7,400	− 200
	£	343,000	341,000	− 2,000
From United Kingdom	tons	660	270	− 390
	£	28,600	12,000	−16,600
,, Japan	tons	1,100	1,400	+ 300
	£	69,000	77,000	+ 8,000
,, United States ...	tons	5,500	5,300	− 200
	£	221,000	228,700	+ 7,700
Electrical generators.—				
Total	£	5,000	15,000	+10,000
From United Kingdom ...		4,000	600	− 3,400
,, United States		500	14,000	+13,500
Electric motors—				
Total		47,000	77,000	+30,000
From United Kingdom ...		28,000	25,000	− 3,000
,, United States		18,000	50,000	+32,000
Other electric machinery—				
Total		141,000	168,000	+27,000
From United Kingdom ...		92,000	108,000	+16,000
,, United States		36,000	43,000	+ 7,000
,, Italy		8,000	12,000	+ 4,000
Mining machinery—				
Total	£	36,000	73,000	+37,000
From United Kingdom ...		17,000	9,000	− 8,000
,, United States		14,000	61,000	+47,000
Electric fans and parts thereof—				
Total		141,000	179,000	+38,000
From United Kingdom ...		13,000	15,000	+ 2,000
,, Italy		49,000	68,000	+19,000
,, United States		74,000	89,000	+15,000
Electric lamps and parts thereof—				
Total		127,000	173,000	+46,000
From United Kingdom ...		46,000	52,000	+ 6,000
,, Holland		40,000	71,000	+31,000
,, Japan		29,000	31,000	+ 2,000
,, United States		10,000	11,000	+ 1,000

	1917-18 £	1918-19 £	Inc. or dec. £
Electrical wires and cables—			
Total	217,000	242,000	+25,000
From United Kingdom ...	42,000	33,000	– 9,000
„ Japan	167,000	183,000	+16,000
„ United States	4,000	20,000	+16,000
Other electrical instruments, &c.—			
Total	301,000	361,000	+60,000
From United Kingdom ...	153,000	158,000	+ 5,000
„ Japan	81,000	62,000	–19,000
„ United States	43,000	105,000	+62,000
„ Holland	14,000	17,000	+ 3,000
Telegraphs, materials for construction and accessories—			
Total	6,000	4,000	– 2,000
From United Kingdom ...	6,000	3,000	– 3,000
Telephones, materials for construction and accessories—			
Total	13,000	17,000	+ 4,000
From United Kingdom ...	6,000	3,000	– 3,000
„ Sweden	5,000	6,000	+ 1,000
„ United States	1,000	6,000	+ 5,000

In addition to the foregoing, the following were imported as Government stores:—

Machinery and millwork—			
Total	177,000	255,000	+78,000
From United Kingdom ...	172,000	244,000	+72,000
Telegraph material—			
Total	150,000	142,000	– 8,000
From United Kingdom ...	149,000	141,000	– 8,000
Instruments and apparatus—			
Total	324,000	306,000	–18,000
From United Kingdom ...	321,000	305,000	–16,000

EXTRA-HIGH-TENSION DISTRIBUTION BY UNDERGROUND CABLE.

Discussion at Manchester.

At Manchester, on January 11th, Mr. R. O. Kapp's paper on the above subject, which was abstracted in our issue of December 17th, was discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. Watson, referring to Mr. Kapp's suggestion that in the past the cost of distributing systems had been comparatively small, differed, because in the majority of undertakings, at any rate, the cost of l.t. distributing networks already in use was as a rule very nearly half the total capital employed. If in the past h.p. transmission had been used to a larger extent, speaking generally, the cost on the distributing and transmission side would have been appreciably lower than it stood in the books of most undertakings to-day. Mr. Kapp mixed up the two important matters of transmission and distribution; there was really a very clear line of demarcation between the two, as the terms were used, but his transmission meant a straight through transmission from point to point with a distribution centre at the end of it or situated at a certain point on its length; therefore, what Mr. Kapp in several instances called distribution was really a main transmission line. The speaker disagreed with Mr. Kapp's figure of £4 per kVA of peak load, which was much too small, especially in view of the fact that he included in that cost the switchgear and the transformers which might be used for distribution purposes at the different points. At any rate, at the present prices of cables and of labour for laying, the cost must come out at a somewhat higher figure than that. The author spoke of distributing 40,000 kW over only 5 square miles. That represented an exceedingly brisk demand in a very small area, which only extended apparently a maximum distance from the generating station of about a mile and a quarter. He could not agree with the statement that "On the other hand, overhead line work is not as cheap as cables when small quantities of power have to be distributed to isolated points of a complicated network," nor with the remark that "In the author's opinion it is very doubtful indeed if engineers will decide in future schemes that the advantages of cable protective gear are great enough to justify its cost." Much could be said for the herring-bone type of lay-out, particularly in the early development of an undertaking; in fact, the speaker did not think they could develop with any system other than a herring-bone type. The cost of point-to-point transmission with no tappings on the way or on the sides would be prohibitive. As time went on the herring-bone system would become a big system, and be connected up to the larger and more important main transmission lines, which by that time would have been constructed as developments occurred. The ring-main system was an ideal system to adopt when it was possible to do so on commercial grounds; but it was not every district which was so constructed geographically as to make a ring main system the ideal one, or even the less costly. In such a case it would be better to construct a duplicate main system, because, although as far as the cables themselves were concerned, they were duplicated, there was only one cost for excavation and one cost for reinstatement which, under the present-day scale of costs amounted to a considerable percentage of the total cost involved. On a ring main it was very desirable that the cross-section of the copper should be the same between the various inter-connected points, because under certain conditions they might be called upon to transmit practically the full power of one of the main feeders going out to that ring main from the generating station; and it was, therefore, essential that the cross-section of the copper should be of the same size as the individual cables coming up from the station.

Mr. Williams, in the absence of Mr. Romero, read his notes for him, in which the chief criticism was that the author only considered capital costs and disregarded losses altogether. He defended that attitude by stating that for the purpose of the rough generalisations dealt with, feeder losses were too small to need considering, which was a most misleading statement. The I^2R losses in a 0.2 sq. in., 3-core armoured cable laid direct and loaded at 250 amperes per core, which was well below the temperature limit of the cable, amounted to about 47 units per hour per mile at working temperature. With a load curve giving losses equal to 25 per cent. of the losses at 100 per cent. load factor, the annual value of these losses at 0.9d. per unit would be £386. The capital charges per mile per annum on a 6,600-volt cable of that size laid and jointed were about £270, or actually much less than the value of the losses. Those were fair average figures, but they could be modified widely without making the value of the losses in the least negligible as compared with the capital charges on the cable. Reduction of losses should never be lost sight of when stand-by feeders were under consideration. In a properly designed system stand-by feeders would generally go a considerable way towards paying their own capital charges by reducing I^2R losses, and in many cases (at pressures up to 6,600 volts at any rate) they would effect a net over-all economy as well as provide a stand-by. The points he emphasised were that at 6,600 volts the most economical loading was often well below the temperature limit; it was unwise and unsafe to run very near the temperature limit, and that the extra cost of running well below it was not very great. In comparing 33,000 and 6,600-volt transmission by capital cost alone, the author was doing an injustice to the 33,000-volt transmission, as for the same current density the losses at 33,000 volts were only one-fifth of the losses at 6,600 volts, whereas the capital cost was one-third. The author's temperature rise curves were ingenious, but the speaker thought most engineers would prefer to have sufficient copper to make it unnecessary for them to watch their cables so very closely. The capital cost of distribution, £4 per kVA of peak load, appeared to be extremely high for such a concentrated area as 5 square miles.

Mr. Radcliffe thought the paper contained much that was distinctly dubious, in so far as it related to purely hypothetical cases. The speaker was startled at the point made with regard to the centre of gravity of the load. It was rather a quibble. Perhaps in some of the hypothetical towns which had length without breadth it might apply; in an ordinary town, with a reasonably symmetrical lay-out, one need not worry about the academic distinction between the centre of gravity of the load and the centre which gave the minimum heating. The new equivalent to the centre of gravity which was based upon heating, apparently ignored losses entirely. He congratulated Mr. Kapp on his ingenious arrangement of transformer taps, which was a valuable scheme, giving an enormous range of voltage with a comparatively small number of taps. Generally he was in agreement with him on the question of changing voltages. The exceedingly short distance at which it paid to change over from one voltage to another was surprising. Another aspect of that matter would become important in the future. In large cities the load was becoming much more dense, and the cost of cables increased not so much owing to the increase in the cost of the cables themselves as to the increase in the cost of laying them. It might be desirable to consider increasing the pressure on existing feeders. Feeders that had been laid for 6,600 volts would undoubtedly be quite safe for a very much higher pressure. Probably another transformer step would not involve a cost in excess of that involved by the laying of additional l.t. feeders. It was pleasant to hear a good word for the cable sometimes, and Mr. Kapp's remarks on protective gear were distinctly refreshing. Some of the papers they had had recently on that subject were disconcerting. A herring-bone system with a number of taps on the cable was very bad, but a system which was practically the same thing, in which the cable was looped in and out of sub-stations, was quite legitimate, and comparatively easy to control. Ring mains had served a very useful purpose in scattered districts, but they were rather overrated for cities or dense areas. The distribution of the future would be, as the author suggested, some combination of the star and link system for the primary transmission, then a secondary star-and-link system, and, lastly, probably some sort of simple radiating system. It was not to be expected that every consumer on a h.t. system could have a duplicate supply any more than he could on an ordinary l.t. system, but all the important mains of the primary transmission would certainly have to admit of alternative routes in case of breakdown. Main feeders must not be tapped, but most engineers would question the desirability of reducing the cross section on ring mains. One result of the author's remarkable curve, No. 6, was that it led to the selection of

0.075 sq. in. as the maximum size of a 6,600-volt cable; in Manchester they had miles of 0.25 and 0.3 cable on 6,600 volts, and they also had cables of similar size in operation on 33,000 volts. Who was right? The heating theoretically seemed to be quite permissible, but nothing was stated about the data on which they were based as regarded permissible heat, current density, and so on, or whether they were equally applicable to 6,600 and 33,000 volts. The maximum temperature was not necessarily the same in the case of both cables, neither was it necessary to depend upon the same factors; that was to say, the limits were not governed by the same considerations. He could hardly agree that it was a suitable occupation for the switchman to dabble with those curves and tracings; he had far more important duties to perform. But something of that sort might ultimately become one of the duties of an operator upon a large system who, for want of a better term, he called "load controller."

Mr. J. B. PALMER agreed that "voltage drop on the e.h.t. system is always so small that it need not govern the lay-out as it does in the case of l.t. systems. In the case of e.h.t. cables, heating and not voltage drop is always the determining factor," but in the case of a power station supplying, not a town, but a group of towns, from a distance for which the voltage was just about the limit, that paragraph might be misleading, because undoubtedly the voltage drop might be very embarrassing indeed. He actually knew of one case where it was so. There were most remarkable differences of opinion upon what constituted average circumstances. It seemed that the expense one would be put to for stand-by plant would be enormously increased were it not for the fact that protective gear was necessary to cut out a faulty section and a faulty section only.

Mr. KAPP, in his reply to the discussion, said that his figure of £4 per kVA was probably too low; he took two limits, thinking that the truth would be somewhere between those limits. In most cases where one had to distribute electricity at, say, 6,600 volts to fairly small industrial consumers, the fixed charges on overhead lines were so high that there would be a limit to the size of the individual load. There were quite a lot of cases where there was a reason for protective or detective gear, but in the majority of cases he would rather expend the money upon better and extra insulation upon the cables. With regard to the 0.075 cable being too small, he did not know what current density was being worked to in Manchester, but they had to work to much larger densities in manufacturing than they did some years ago. According to the figures he got from manufacturers a 0.075 cable could safely take a load now for which ten, or even five years ago, they would have used a much heavier cross-section. If the Manchester cables were put down at the present date, the mains engineer would probably have a smaller section. With regard to the point that if they wanted to transmit 40,000 kW a 0.075 sq. in. cable would involve a very large number of cables, the 0.075 cable he had in mind was for a case of distribution, in which they would only have two or three, or perhaps four, parallel feeders, and in each case they would want a stand-by feeder. If they connected up to a very large works and had five, six, or more parallel feeders, one stand-by was a small proportion of the whole lot, then it was best to make each of them of a larger cross-section. The suggestion that the economic section of cable was often below the safe current density had been made in other places where the paper had been read, and it had been said that Kelvin's law gave a current density for a 6,000-volt cable which was lower than the safe current density, but he could not agree at all; there must be some misapprehension about how one should apply Kelvin's law to those cases of distribution. When Kelvin devised that law he had in mind the laying of one cable, and the problem was to determine the best cross-section of copper for that one cable. At the present day their cross-section of copper was fixed; generally it was a case of laying extension feeders. They were going to make them of the same cross-section as the existing feeders; therefore, the whole of the cost of the cable, plus the cost of laying and making good the ground, and everything else involved, varied as the cross-section; and the capital charges on all those must be equated to the losses to give the economical current density. In those cases it would be found that for the 6,600-volt cable the density given by Kelvin's law was always very much in excess of the safe current density for heating. The position of the economical site of the power house was given by Carrothers's method, even if they took account of the losses; in fact they could add the cost of the losses to the capital charges, and the economical position would still be given by Carrothers's method.

DISCUSSION AT BIRMINGHAM.

The paper was also discussed before the SOUTH MIDLAND CENTRE at Birmingham on January 12th.

Major A. M. TAYLOR questioned the author's diagram which showed that at a distance of five miles from the generating station the cost of a 6,600-volt system would be the same as that of a 33,000-volt system, and gave particulars of a case which had been worked out in Birmingham. A sub-station with a present demand of 6,000 kVA was fed by three 0.15 sq. in. trunk feeders working at 1,500 amperes per sq. in. It was desired to double the voltage on those trunks on account of voltage drop; the question to be considered was whether it was best to put in three additional cables or to introduce step-up and step-down transformers and transmit the whole 12,000 kW over the three existing mains. The result of the investigation was that on a two-mile transmission there would be an annual loss of £0.16 per kVA, on a three-mile transmission a gain of £0.16 per kVA, and on a five-mile transmission a gain of £0.80 per kVA. Some mains were as long as the latter, and in such a case the gain per annum would be about £30,000 on the total quantity of power which it was contemplated to transmit.

Mr. W. BREW said that some of the author's diagrams appeared to assume that the total cost of cable per unit of length was proportional to the sectional area of the copper. That assumption would only be approximately correct in the case of the largest cables, and took no account of the cost of trenching and reinstatement. When it was remembered that for medium and small e.h.t. cables laid singly the cost of trenching and reinstatement approached a figure nearly double that of the cable itself, it would be evident that the form of the diagrams referred to would require to be modified.

Mr. W. E. GROVES observed that it was not possible to foresee the conditions that would arise during the development of a large supply scheme and, unfortunately, networks had to be planned a long time before the anticipated demand was realised. In the interval unexpected loads might turn up, and it was necessary, therefore, to adopt a step-by-step policy of planning. At the same time the design had to be based with some ultimate lay-out in view, and the present paper was, therefore, of great interest though limited in its application. The speaker agreed with the author's comments on the reliability of cables, and also that heavy outlays on pilot protection systems for distribution networks on a large scale were difficult to justify.

Mr. W. WILSON mentioned that his own experience in e.h.t. transmission had been solely with overhead systems. In those there was a well-defined relation between length of transmission and voltage, resulting in the rate of about 1,000 volts per mile.

THE ELECTRICAL CONTRACTORS' ASSOCIATION (INC.).

ANNUAL DINNER

ON January 19th the annual dinner of the Electrical Contractors' Association (Inc.), the N.E.C.T.A., Ltd., and the National Federated Electrical Association was held at the Connaught Rooms; the president, Mr. P. Collinson, was in the chair, and amongst the guests were Messrs. Ll. B. Atkinson, R. Tweedy Smith, A. Albrecht, P. F. Rowell, J. Y. Fletcher, J. W. Beauchamp, Col. H. M. Leaf, Major H. Richardson, Messrs. H. G. Purchase, M.P., H. Hirst, C. H. Wordingham, E. C. Wansbrough, A. C. Cramb, L. Gaster, F. B. O. Hawes, and A. G. Beaver.

After the toast of "The King" had been duly honoured, Mr. H. HIRST proposed "The Allied Associations and Honorary Officials." He claimed that no one had done more than he to establish the contracting industry on a sound basis; in other countries installation work was carried out by the large manufacturing firms or companies owned and controlled by them, and in this country in the early days the same condition had obtained. When, in 1886, he proposed to start a business for the supply of electrical apparatus, he was laughed at. His first catalogue of 1886 was designed to help the big firms, which had found that contracting did not fit in with their business, and sublet the contracts to their foremen, who were the first contractors. The big firms boycotted him because he gave away too many "secrets" in the shape of hints for wiremen. All his life he had devoted attention to the contractors, whose wants he supplied, and when they formed an association he took the keenest interest in it, considering that by that step they had elevated their status. He urged that further progress should be made in that direction with a view to promoting efficiency, and cited a bad lay-out as an example of the harm done to the industry by an inefficient contractor. In Germany and the United States, he said, the producer imposed his will on the consumer; here the consumer's views prevailed, with unfortunate results. The contractor was the link between the manufacturer and the consumer, and should study the problems that were met with in the vast field of domestic applications of electricity that was opening before the industry.

Responding, the CHAIRMAN thanked Mr. Hirst for his "scathing remarks," and said that the most important matter before the Electrical Contractors' Association was the question of registration or licensing of contractors; the time had come when the type of contractor to which Mr. Hirst had alluded should be eliminated from the trade, and the unskilled man prevented from setting up in business. The Board of Trade would not accept the proposed scheme, but sooner or later they hoped to gain their end. The E.C.A. was also dealing with the training of apprentices; committees had been formed in all the large towns to supervise their training, and to make arrangements with the local education authorities for classes, with a view to turning out a man much in advance of the present operative. The question of municipal trading had received their attention, and they hoped soon to get into closer touch with the municipal engineers, and to arrive at an understanding with regard to their respective spheres.

The N.E.C.T.A., which was formed to enter into trading agreements with manufacturers, had not made the progress that was anticipated, but their agreement with the Cable Makers' Association had operated most satisfactorily; there was not a single case of unfair trading in the past year. Such an agreement was of mutual benefit, tending to keep the foreigner out of our market. To-day, assisted by the high rate of exchange and the low cost of living, the German manufacturer was in a good position to attack the British market; the samples were here already, and the goods would follow. The National Federated Electrical Association was formed to settle wages with employés; other sections of the industry thought they were paying excessive rates, but they were a small body, under great pressure. They contemplated linking up with the Engineering Employers' Association, with whose guidance they hoped their future settlements would not be so much open to criticism. They could readily come to an understanding with the Electrical Wholesalers' Federation, and the Electrical Development Association might play a great part in the future of the industry. More linking up of Associations was desirable, to remove friction and avoid loss of energy.

Mr. H. G. PURCHASE, M.P., also responded, laying stress on the importance of efficiency, and claiming that in the exercise of scientific imagination this country excelled the United States and Germany.

Mr. H. J. CASH, proposing "The Guests" (I.E.E. and kindred Associations), said that contractors often did not attach sufficient importance to membership of the Institution. The old views of the Institution were dispelled; it was a body which looked after the interests of the whole industry, every section of which was represented on the Council and committees, and at its meetings they met engineers and manufacturers on common ground. As a member of the Council, he knew that the contractors were welcomed and regarded as fellow engineers, and their advice was sought in all matters in which they could afford assistance. The contractors had not always seen eye to eye with the I.M.E.A., but really their interests were identical, and they ought to make common cause in the future. The Cable Makers' Association worked in harmony with them, not only for financial benefits, but for the general interests of the industry, and their joint committee provided for the exchange of views and promoted good feeling. The Electrical Development Association was one of the great powers of the near future, and ought to be supported by every branch of the industry. The Electrical Trades Benevolent Institution was doing an enormous amount of good, and the Illuminating Engineers' Society's work was of great benefit to contractors.

Mr. LL. B. ATKINSON, responding, emphasised the importance of combination in industry, and complimented those who had developed the Association out of so widely scattered a body as the contractors. The Association had already immensely raised the status of the industry, and he did not agree with Mr. Hirst as to the technical ability of the contractors, many of whom, to his knowledge, had nothing to learn about their business. The trading agreement with the Cable Makers' Association, which had been made in the face of great difficulties, was not only useful to the contractors by standardising their position, but had been valuable to the cable makers in classifying their customers. On the whole, its advantages had been enormous. Other associations which did not make the same experiment were lacking in progressiveness. The Institution of Electrical Engineers was a powerful instrument for the good of the industry; it was the largest institution in the country, and in enterprise and ability second to none. The Cable Makers' Association, which had existed for 24 years, had aroused the deepest hostility in the early days, but that feeling had passed, and in his person the I.E.E. had recognised its merits.

Major H. RICHARDSON, president of the I.M.E.A., also responded, and on behalf of his Association, said that the desire for co-operation was never before so real and earnest. Experience had taught them the value of tolerance; to-day the electrical industry had the world at its feet, and they were all entitled to participate in the good times that were coming. The time had come for the amalgamation of many bodies with closely similar objects, to the advantage of all parties, including the customer. The I.M.E.A. was on the verge of holding important conferences with the E.C.A., and would come to them determined to seek a happy outcome from the negotiations. The domestic heating and cooking load was going to be a very big thing, and was starting already. The I.M.E.A. was considering the all-important question of tariffs; personally, he was wedded to the fixed charge plus the smallest possible running charge. A really cheap price was essential. The tariff should be reduced to the simplest terms, which could be understood by the man in the street; mathematical accuracy was out of place in quoting to the consumer.

Mr. W. R. RAWLINGS proposed "The Electrical Trades Benevolent Institution," which he thought had not been adequately supported by contractors; they should help to make the home they were going to a little more comfortable. They could not foresee the future, and they would be surprised if they knew the positions that had been occupied by the people who came to them for help.

Mr. J. Y. FLETCHER, in reply, said the contractors had supported the Institution, but the fund could not do what it should do; the industry was big enough to carry its own casualties, and a very energetic and concerted effort would be made later in the year, to put the fund on the broad basis which it should possess. It could deal with current needs, but would have to face much heavier calls in the near future. He looked forward to a generous response to the campaign, and laid stress on many small subscriptions in preference to a few large ones. The Institution, perhaps, had not advertised itself sufficiently, had not yet made an adequate appeal to the industry. He concluded with special thanks to the electrical Press for its generous assistance to the Institution.

Mr. W. CROSS proposed "The Chairman," one of the oldest members of the Association, and one of the founders of the Bradford branch, past chairman of the Northern Section, and a member of Council for many years. The toast was accorded musical honours, and in responding, Mr. COLLINSON referred to his retirement from business due to ill-health, and his approaching retirement from the office of president. Often it seemed that they were working hard and not making progress; but looking back over a period of years, he saw that they had made progress, and established the contracting industry on the footing of a trade in itself.

A musical entertainment was provided under the direction of Mr. E. L. Halford, F.R.C.O., and the function as a whole was regarded as an exceptionally successful and enjoyable one.

ELECTRONS.

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

(*The twelfth Kelvin Lecture, delivered before* THE INSTITUTION OF ELECTRICAL ENGINEERS.)

IT is at the wish of your Council that I am speaking to you this evening on the subject of electrons.

Without this explanation you may well be amazed at my attempt to deal with so large a subject, on which Sir Oliver Lodge and others have spoken to you on many different occasions. But, of course, I set myself certain limits, and propose to speak mainly on two lines of recent research, referring to the part played by the electron in radiation processes and to the part it plays in atomic structure. And first, with your permission, I will put in a background of general facts.

In recent years the results of experimental research on the properties of electrons have accumulated with startling rapidity. As knowledge grows, the importance of the part played by the electron in the mechanics of the world becomes even clearer. There are all the right signs that progress is being made along a road that really leads somewhere; we are continually finding that, through some electron action, phenomena are linked together between which we had hitherto seen no connection. Precision is given to our views; we find ourselves able to express, quantitively and with confidence, laws and relations which have been matters of vague surmise. Every experiment that is finished suggests others that are promising. The whole world of experimental physics is full of new life, and of the consciousness that after a period of hesitation the tide of discovery is sweeping on again. I hope I may be allowed to claim that when an advance is made in the realm of physics all other natural sciences feel the impulse sooner or later.

While knowledge grows by experiment, theory is also busy. The attempts to co-ordinate the new discoveries are of singular interest because of their daring, their width, and their strength; because they are so often fruitful in prediction; and, not least, perhaps, because they seem so often to be irreconcilable with each other.

Altogether, then, a lengthy course of lectures might well be devoted to the subject of electrons, as indeed is the case in our universities. But your Council has asked me to confine myself—and I assure you I am very thankful for the restriction—to a brief description of the main features of a great inquiry, and of the direction in which that inquiry is moving.

It helps to a right appreciation of the position as regards the electron if we observe its strong resemblance to the older state of things when first the atomic theory of matter was clearly defined. Just as chemistry has grown and prospered on its recognition of the unit of matter, so electrical science has already begun a new life, and to all seeming, a most vigorous one, based on the understanding of nature's unit of electricity. There are many different atoms of matter, nearly a hundred are distinguishable by their different chemical reactions; but the number of different kinds of electrical atoms is very much more limited. We are clear as to the existence of one, the electron, nature's unit of negative electricity. We suppose that there is a definite positive counterpart, but our ideas about it are much less precise. We seem to get along very well at present without any intimate knowledge of the positive, or perhaps we should say positives; for present purposes the negative unit is that which gives definition to our work.

If the chemist has found so much profit in his recognition of the fact that nature has just so many ways, and no more, of doing up parcels of matter, the electrician will surely gain in the same way, when he grasps the fact that electricity is not merely measurable in quantity, but that there is already a unit of nature's choice, possibly no more than one unit.

We may say with justice that the most wonderful advances in modern physics are the reward for our appreciation of this truth, and we may hope with equal justice that we are yet far from reaping the full benefit.

The first suggestion of the atomic character of electric charge came, it is well known, from observation of the laws of electrolysis. Since the movement of atoms or atom clusters or ions across the electrolytic cell was accompanied by a simultaneous transfer of electricity, in which each ion, of whatever nature, bore always the same charge or at least a simple multiple of it, there was a clear indication that this division of electricity into parcels of constant magnitude implied the existence of some natural unit charge. No progress, however, was made or could be made so long as the charge could only be observed as an attachment to an ion; it was not even clear that it could ever have a separate existence. In the long series of researches which finally led to the isolation of the electron and the determination of its properties, there were certain that marked definite stages in the forward movement. Crookes examined the electric discharge in bulbs exhausted to a high degree by the new air pumps which he had succeeded in making; and he observed the so-called cathode rays, streaming away from the negative electrode. He showed that they possessed the properties to be expected from a stream of particles projected across the bulb, and carrying negative electricity with them; for, on the one hand, they could heat up bodies on which they fell, and on the other, they were deflected in crossing a magnetic field. Crookes spoke of a fourth state of matter, and defended his view against the opposing hypothesis, held largely on the Continent, that the stream consisted of electromagnetic waves in some form or other. Hertz showed that the rays could pass through thin sheets of matter such as aluminium leaf, and Lenard took advantage of this to coax them outside the bulb and display their effects in the air outside.

In the later years of the last century came the great experiments of Wiechert, Thomson, and many other well-known observers who weighed the electron and measured its charge, and showed that there was only the one electron though it was to be found everywhere and in every body. Since then, the measurements of these quantities have been repeated many times with increasing skill and understanding. They have reached their present high-water mark perhaps in the experiment of Millikan at Chicago, who gives us the value of the charge in electromagnetic units $e = 1.591 \times 10^{-20}$, the mass being 0.903×10^{-27} gramme or 1/1 830 of the mass of the hydrogen atom.

So we arrive finally at an accurate comparison of these unique and fundamental units of nature with the units which we ourselves have chosen for our convenience, and without, of course, any relation to the other. We infer from experiments such as those of Kaufmann and Bucherer, that the energy of the moving electron may be considered to exist wholly in the form of electromagnetic energy such as is necessarily present when an electrical charge is in motion; and that its mass is in this way perfectly accounted for. But this conclusion sets a limit to the size of the electron and we must assume that its radius, if its form is spherical, is not more than 10^{-13} cm. or about a hundred-thousandth of the radius of any atom.

Why, we may well ask, have these measurements of charge and mass never been made before? The electron is everywhere; the transfer of electricity from place to place consists always in the transfer of electrons. The electric current is a hurrying stream of electrons; all our electrical machinery concerns itself with setting these in motion, giving them energy, and again withdrawing it. In the processes of electrolysis, the electrons are handed to and fro. Everywhere they fill the stage, why have we not noticed hitherto their qualities, which so far can be expressed so simply?

The answer is that we have never, until recently, been able to make them move fast enough in spaces sufficiently empty of air or other gases. It is only when an electron has a sufficient speed that it can escape absorption in the atoms which it must be continually meeting. Unless an electron has a speed exceeding about a three-hundredth of the velocity of light, that is to say, such a speed as it acquires in falling through a potential of a few volts, it sticks to the next atom it runs up against; even with ten times that speed it can only move a fraction of a millimetre through air at ordinary pressure before it loses its velocity and, therefore, its power of going through the atoms. When Crookes first saw the cathode-ray stream in full course, it was because he had reduced the number of gas molecules in his bulb to such an extent that an electron could fly in a straight line from end to end of the bulb without going through more than a hundred atoms or so, and the induction coil had given it quite enough speed to do that without turning out of its course; no matter what sort of atoms they were. Incidentally, since atoms can be traversed in this way, we naturally think of an atom as a very empty affair.

Electrons flying still faster than in the discharge tube are found to constitute a part of the radiation from radioactive substances. Some of the β-rays have velocities nearly equal to that of light, and can pass through millions of atoms before their energy is spent. In open air a β-ray may have a course of metres in length, though it is generally broken, by encounters with traversed atoms, into a path of corners and irregularities.

It is speed which gives separate existence to the moving electron; and speed which also betrays its presence to us. For, on its way, the electron here and there chips away another electron from an atom which it is crossing and leaves behind it a separation of electricities which may subsequently influence chemical action as in the case of the phosphorescent screen or photographic plate, or provide a current for the ionisation chamber. We do not know exactly how this removal of electrons is effected, nor why some atoms part with electrons more easily than others so that the flying electron loses less energy as it goes through; there is much that is obscure in the whole process. But it gives us a ready means of observation, without which indeed our knowledge of the electron would be far less than it is.

These electrons which are so made manifest by speed form but a minute fraction of their whole number. They are to be found in every body, and in every atom of every body. They form one of the elements of construction of every atom; and it is one of the most immediate aims of present research to find in what way they are built into atomic structure. In every atom there are electrons of which one can be removed at the cost of a certain amount of energy, of the order of 10^{-11} erg; part or perhaps all of which may be recoverable, so that the store of energy in the atom remains what it was. The potential through which an electron must fall so that it acquires this energy, and is able to effect this removal when it strikes the atom, is known as the ionisation potential. Whether a second electron can be removed at anything like the same cost is difficult to say. There are other electrons with the atom which are intrinsically far more difficult to remove. On the other hand, some atoms, for example, those of the metals, have each one or more electrons which are little more than hangers on, and are indeed removed with very little trouble. A block of pure metal is full of such loosely bound electrons, so that if an electric potential difference is maintained across the block an electron flow or electric current is produced. The metal "conducts."

At sufficiently high temperature all bodies become conductors; we must imagine that the violent thermal agitation shakes electrons free from their ties to the atoms even when at low temperature the bonds ordinarily remain unbroken. At high temperature, too, the electrons acquire high velocities as they move too and fro with their proper share of heat energy. At the surface of the hot body the electrons may break away; and hence the "thermionic emission" investigated by O. W. Richardson. So copious is this supply of electrons at the surface of a hot body that if the latter is made negative in potential relative to its surroundings there is a current discharge which may sometimes be measurable in amperes. Of course, such a current can only pass one way, negatively from the hot body, or positively towards it. So we get the basic principle of the "valve," and so Coolidge provides the electrons for projection against the target in the X-ray bulb which he has designed. At this point we find already the adaptation of our new knowledge of electrons to apparatus of extraordinarily great use to mankind.

If we now plunge a little deeper into our subject we come to certain most fascinating regions of it, where exploration is still in full progress. In one of these we find the most remarkable connection between moving electrons and electromagnetic waves. The one, it seems, can always call up the other; and the action obeys certain precise numerical laws.

Let us take as an example the production of X-rays in a Coolidge bulb. A plentiful supply of electrons is provided at the cathode by heating a fine spiral of tungsten wire to a high temperature. A high potential difference between cathodes and target is provided by some approximate means, and the electrons are hurled at the target, each possessing an amount of energy equal to the product of the electron charge and the applied potential. Where the electrons strike, some of their energy is converted into electromagnetic waves of very high frequency, the so-called X-rays. Suppose that we measure the energy supplied to each electron—not an easy matter with the usual arrangements, but very easily done if, as in certain experiments of Duane and Hunt, at Harvard University, the potential is derived from a great storage battery of 20,000 volts. Suppose, further, that we analyse by the X-ray spectrometer the X-ray radiation that issues from the target. We find that the frequencies of the emitted rays may have a wide range of values, but that the upper limit of the frequencies is always proportional to the energy of the electron, and, therefore, to the potential imposed on the tube. This ratio remains the same no matter what is the intensity of the electron discharge, and no matter what the nature of the target. This ratio of electron energy to maximum frequency is a number which has turned up in previous cases where the emission of radiation energy has been measured; it is known as Planck's constant, and is denoted by "h." Its value is 6.55×10^{-27}. Although the constant has been met with before, there is probably no instance where the transformation of energy which it governs is so simply displayed or so easily measured as in the case just described.

In certain measurements made by Duane, the X-ray spectrometer was set to observe the presence of a certain frequency as soon as it appeared. The potential on the tube was then increased by degrees. The rays of the given frequency appeared as soon as the energy supplied to the electron was equal to the frequency multiplied by h. As the potential was increased still further these rays increased in intensity.

It is to be observed that the production of X-rays is an aggregate of individual efforts by separate electrons; each

electron produces its own train of X-rays when it strikes the target. There is no sign of any combined action, as indeed is evident from the fact that the intensity of the cathode-ray stream is without influence on the frequencies of the X-rays produced.

The crucial point is that where the energy of an electron is handed over in whole or in part, the frequency of the X-ray waves that take over the energy is determined by the quantity of energy handed over. This explains why there is a limit to the frequency of the X-rays; it is because there are some electrons, though only a fraction of the whole number, which give up all their energy to the formation of X-rays at the moment of striking, before they have lost energy in collisions. The rest of the rays, all those which have lesser frequencies, will come from electrons that have lost speed in this way, or possibly have transferred only part of their energy. The atom of the target is playing the part of a transformer, and does not determine the frequency, so far as these effects are concerned.

All this is wonderful enough; but the marvel is greatly increased by the discovery that the effect is reciprocal. Just as the swiftly moving electrons excite X-rays, so X-rays when they strike any substance lose their energy, which now appears as the energy of moving electrons. And, again, we find the same variation in the result and the same limit to that variation. Among the electrons so set in motion we find, examining them as soon as possible after their motion has begun, every variety of energy-content up to a certain critical value which is equal to the frequency of the X-rays multiplied by the same constant h. It is to be observed that we cannot measure all the electron velocities as soon as they exist because some of the motions begin in the body of the substance, into which the X-rays have penetrated, and have lost speed on the way out. Again, therefore, there is nothing against the hypothesis that the energy of every electron set going by waves of given frequency is originally the same, and is determined by the standard condition already given.

Not only in the case of X-rays are these effects observed, but also in the case of light. The only difference is that the frequencies of light vibrations are some 10,000 times less than those of X-rays, and the electron energies are correspondingly smaller. When the light waves produce the electrons we have what is known as the photo-electric effect. The production of light by electrons has been much studied recently in experiments to find "resonance-potentials," that is to say, the magnitudes of potentials which must act on electrons so as to give them enough energy to excite certain particular radiation from atoms on which they fall.

Exactly how this strange transfer of energy from one form to another takes place, we do not know; the question is full of puzzles. The magnitudes involved are hard to realise; it helps if we alter their scale of presentment. Suppose that the target of the X-ray bulb were magnified in size until it was as great as the moon's disk, that is to say, about 100 million times. The atoms would then be spheres a centimetre or so in diameter. But the electrons would still be invisible to the naked eye. The distance from earth to moon would correspond roughly to the distance that ordinarily separates the bulb from an observer or his apparatus. We now shoot electrons at the moon with a certain velocity; let us say that in every second each square yard or square foot or square inch, it does not matter which, receives an electron. A radiation now starts away from the moon which immediately manifests itself (there is no other mean manifestation whatever) by causing electrons to spring out of bodies on which it falls. They leap out from the earth, here one and there one; from each square mile of sea or land, one a second or thereabouts. They may have various speeds; but none exceed, though some will just reach, the velocity of the original electrons that were fired at the moon. That, reduced again to normal size, is the process that goes on in and about the X-ray bulb; which is part of a universal natural process going on wherever radiation, electron, or wave, falls on matter, and which is clearly one of the most important and most fundamental operations in the material world.

(To be concluded.)

ELECTRIC ARC WELDING APPLIED TO ALUMINIUM.

By F. J. HEYES, B.Eng.

THE following is an abstract of a paper which was read at the Liverpool Sub-centre of the North-Western Centre of the INSTITUTION OF ELECTRICAL ENGINEERS, on January 17th:—

Ever since the discovery of aluminium the greatest difficulty has been experienced in joining pieces of it together, either by soldering with some other metal, or alloy, or by autogenous welding.

The first and greatest difficulty to be overcome is the affinity of aluminium for oxygen. In order to get any two pieces of metal to unite, it is essential that the surfaces should be free from any coating of solid dirt or oxide which will prevent them coming into intimate contact. The affinity is so great that even at ordinary temperatures a clean surface quickly becomes thinly coated with oxide, and at temperatures approaching its melting point it immediately becomes thickly coated, and small pieces of the metal will burn away completely. The melting point of the oxide is far above that of the metal, so that it is impossible to weld two pieces together without some flux which will dissolve or get rid of the oxide.

With a plain aluminium rod without any coating of flux, on striking the arc the metal instead of dropping off as soon as it is melted hangs in globules on to the end of the electrode till they become as much as half an inch in diameter, when using a number of electrodes, they then fall on to the plate which is to be welded. These globules become thickly coated with oxide, and so does the plate, so that when they drop off they adhere to the plate only at the point where they are playing, and when cool they can be easily pulled off with the fingers. All the time that this is taking place thick clouds of fumes are given off, and eventually the pieces of aluminium which were to be welded melt, but show no signs of adhering to one another. The thick clouds of fume are probably due to the fact that some of the aluminium is vaporised by the intense heat of the arc, and burns away much more freely.

There are three ways of dealing with the oxidation: First by protection of the surfaces from contact with the air and consequent oxidation, by some flux which fuses easily and will not prevent the surfaces coming together. Secondly, by solution of the infusible oxide in some fluxible substance which does not affect the quality of the weld; and thirdly, by chemical combination of the oxide to form some substance which is fusible at the temperature of melting aluminium, or a combination of the oxide to form some substance which is fusible at the temperature of melting aluminium, or a combination of these may be used.

Perfect protection of the surface cannot be obtained in practice, so that it is necessary to combine protection with solution in one form or another. Chemical combination has the disadvantage that any substance that combines with the oxide will also combine with the aluminium, and so may be used up before dissolving all the oxide, or portions of it may become embedded in the deposited metal and cause subsequent corrosion. Hence solution of tin oxide in some solution which is chemically suitable when in contact with aluminium is the best method if obtainable.

Chlorides of the alkaline metals are very suitable for protection of the molten surface from contact with the air, as they melt below the melting point of aluminium, and do not interfere with the making of the weld. Fluorides of the alkaline metals and of aluminium have the property of dissolving aluminium oxide without chemical combination, so that they would appear to be the most satisfactory if there were no other obstacle to their use. Bisulphates of the alkaline metals being unsaturated compounds can combine with the oxide, and are very useful for this purpose.

Arc welding of aluminium has been attempted by the author, using the ordinary acetylene welding fluxes, without any success whatsoever, and he reached the conclusion that it is essential to use a flux which is not easily vaporised. For this purpose he found cryolite suitable. In arc welding a small pool of molten aluminium is formed at the point being welded, the temperature of which is far above the melting point of the metal, some of the aluminium being deposited in the form of vapour. At this temperature the cryolite becomes quite fluid, and runs freely on the surface, enabling a very good weld to be made. In trying to weld with a plain electrode the aluminium hangs in globules at the end of the electrode, as already explained, and there is still a tendency for this to occur when using cryolite alone. A small percentage of chloride, however, overcomes this difficulty and renders welding much easier.

In arc welding it is essential to have a coating of flux on the outside of the electrode, as otherwise the aluminium in passing from the end of the electrode to the work becomes so thickly coated with oxide that a very large quantity of flux would be required to deal with it. Where the electrodes may be subjected to rough handling it would be very desirable to have the flux enclosed in the electrode, but as this is impossible, it becomes necessary to fix the flux on the outside of the electrode, which may be done satisfactorily with a binding of fine cotton.

In welding iron or steel a current of about 80 amps. is required for a plate about ¼ in. thick, using a No. 8 electrode, but to weld a similar sheet of aluminium satisfactorily it is necessary to use about 150 amperes. The only explanation offered for this is that aluminium is a much better conductor of heat than iron, and as it is necessary to keep the pool of metal at the point being welded well above the melting point it is necessary to use a much higher current. When the plates being welded are cold it is impossible to weld with a smaller current, but if the work be preheated to about 400 deg. C., a good weld may be made with about 60-80 amps. This bears out the above explanation, as the melting point of aluminium is only 500 deg. C. it does not require so intense a heat to keep the point being welded above this temperature if there is only about 180 deg. C. difference between it and the surrounding portions of the material.

The welding current should increase with the thickness of the plate; for ¼ in. thickness 120-130 amps. is required, for ½ in., 140-150 amps. The reason for this is that with a thick plate there is a greater area to conduct away the heat from the molten pool under the electrode than there is with a thin one. In welding a very thick plate a condition is reached where heat is conducted away from the greater part of the surface of a sphere of which the point being welded is the

centre. For plates thicker than that corresponding to this condition no increase in welding current is required.

The possibility of producing a pool of metal well above the melting point at the spot being welded without heating up the whole plate to the melting point, is one of the great advantages of arc welding over oxy-acetylene welding. In work which has been welded with the oxy-acetylene flame it is frequently found that the pieces have run together only on the surface, as if the operator attempts to melt the aluminium to a greater depth a large portion of the work may be melted out. This is not so likely to happen when using the electric arc, as the heating effect is much more local.

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176. "Rail-less tramway, &c., vehicles." R. H. Wilkinson. January 4th.
231. "Submarine signal receiver." A. W. Särnmark. January 4th. (Sweden, December 1st, 1919.)
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256. "Rectifier." W. B. Lucas and E. L. Markey. January 4th. (United States, July 31st, 1916.)
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795. "Vacuum cleaning devices." Apex Electrical Manufacturing Co. January 7th. (United States, July 9th, 1915.)
796. "Suction cleaning devices." Apex Electrical Manufacturing Co. January 7th. (United States, September 29th, 1915.)
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